METAL FINISHING

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

FEBRUARY, 1949 VOLUME 47 • NUMBER 2

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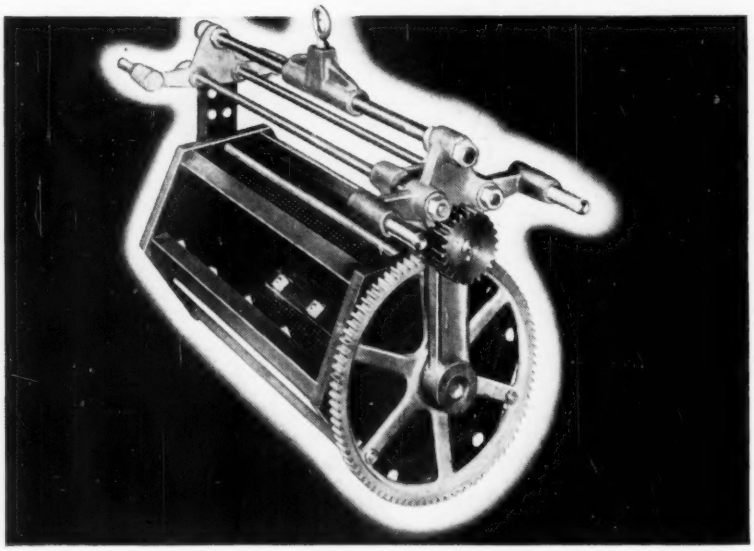

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METAL FINISHING

Partners or Rivals?

One of the easiest ways of stirring up a hornet's nest of arguments and counter-arguments these days is to mention the word "electropolishing" to a gathering of finishing men. No subject has been so hotly debated since the early days of the "generator vs.. rectifier" arguments, in the heat of which it was often proclaimed that eventually one or the other would completely dominate the field, with the loser being relegated to a minor position of little importance. Time has proven that such extreme visions were lacking in good judgment, for today we find both types of power sources maintaining an equally important place in the industry.

Much the same type of thinking is now taking place on electropolishing vs. mechanical polishing and buffing. Idealists aim at the complete elimination of the age-old mechanical methods, and while this is indeed an ambitious goal and quite possible of attainment, we believe that, as in the case of the power supplies, the eventual outcome will find both methods firmly established on an equal footing.

By far the most logical use for electropolishing techniques seems to be as a *supplement* to mechanical methods. There can be no doubt, and indeed there is already considerable proof that the finer abrasive operations before plating, as well as the coloring and buffing operations between plating operations, can be by-passed in favor of electropolishing in a majority of cases. The most important function of electropolishing, however, would seem to be the removal of the so-called "Bielby layer" of heavily distorted surface metal common to all mechanically polished or buffed surfaces. Many researchers have shown the profound effects that this base metal surface can have on the properties of subsequently deposited metals—adhesion, crystal size and orientation, stress, etc. Even if electropolishing failed to eliminate a single mechanical operation, its inclusion as a step in the pre-plating "cleaning" cycle could be justified on this one factor alone. The problems of adhesion and stress may seem of less practical importance today than the elimination of costly surfacing operations, but the long-range significance cannot be underestimated. While the high costs of mechanical finishing may not always be with us, the future applications of electroplating *will* depend on how permanent is the bond between the base metal and the deposit, as well as other factors that are influenced by the surface condition of the base metal.

As a matter of fact, parts that are to be subsequently electropolished before plating do not require the elaborate pre-cleaning and after cleaning treatments now considered essential to the preparation of a surface suitable for successful electrodeposition, and is certainly within the bounds of reason to prophesy that the elimination of cleaning steps, rather than the elimination of polishing or buffing, may turn out to be the principle advantage of electropolishing after all.

Decorative Electroplating on Aluminum

By **Glenwood J. Beckwith**, *Automatic Polishers, Inc., Los Angeles, Calif.*

COMMON base metals have been plated for many years but aluminum is somewhat of a newcomer into the realm. In spite of the difficulties platers have reported in attempting to secure satisfactory plated coatings on aluminum, some shops have made commendable progress.

This progress has not been accidental, nor has it been all traceable to improved plating methods. In a few words, it has been a combined effort of the foundryman, the polisher, and the plater, due respect being acknowledged to the metallurgist and chemist.

Die-casting foundries have produced zinc items for some years that have been satisfactorily polished and plated. When zinc die-cast machines are used to produce aluminum items for plating, trouble seems to start. Many foundries whose products are usually sold with a ball burnished or painted finish suddenly discover that a high polish with a modern bright electroplate reveals surface imperfections that seemingly never existed. Blasting and burnishing operations tend to peen and cover up surface discrepancies. Painting actually hides all small defects by filling them up with pigment.

The Author

Mr. Beckwith is a graduate of Case Institute (Ch. E. 1933), and since that time has been intimately connected with the plating industry in supervisory and research positions with such companies as Amer. Steel & Wire, Basic Magnesium, Inc., Chrome Engineering, National Bronze & Alum. Foundry, as well as Automatic Polishers, where he is in charge of all plating operations. He also holds several patents on plating developments.

Greasing and buffing operations replace the above finishing steps when aluminum items are to be plated. These operations will reveal major surface defects such as flowers, cold shuts, misruns and the like. But oftentimes the polisher is unable to see fine surface porosity, for usually his belts and wheels tend to smooth over such discrepancies. Actually the polished article may look smooth when reflected to ordinary light. Yet after alkaline cleaning, especially if improperly done, close visual inspection will reveal surface pits.

Admittedly, authoritative recommendations suggest some very potent chemical solutions to the plater. It is little wonder that baths such as concentrated nitric and hydrofluoric acids, when allowed to attack aluminum, cause surface roughening, destroy highly polished surfaces and even re-open solidification porosity that is smoothed over in the buffing operation. It is true that some of the stronger acids do a quick and thorough job. Actually, it has been observed that a mild acid-bath treatment after cleaning does a sufficiently adequate job on aluminum die castings, stampings and extrusions. It has been the object of most authorities to completely dissolve the compounds of silicon, copper, magnesium, nickel, etc., produced in the plater's cleaning cycle. In production this has been found unnecessary. With proper precaution in buffiing, de-greasing and pre-soaking, an alkaline cleaning step can be very short and therefore the smutty compounds of the alloys are not allowed to form. Even if items are slightly over-cleaned to a light brown, no ill effects are discernible after plating.

One of the major objectives from the standpoint of hazards to workers, tank maintenance, drag-out losses, chemical costs, and over-cleaning and pickling, has been to eliminate the use of "etch" type cleaners and nitric-hydrofluoric acid. This has been accomplished in commercial production plating as hereinafter described.

Here on the West Coast, finishers of zinc die-castings and sand-cast brass items are aware of spiraling shipping costs to Eastern markets. The lightness of plated aluminum places Western items on a competi-

tive basis in the East. Thus the driving power behind the finishers is evident. The only barrier at the present time is the decreasing supply of raw aluminum.

Figure I shows a few of the many items being commercially plated in volume. In addition to those illustrated are such articles as interior door knobs, escutcheons, cosmetic and cigarette cases, lighters, trays, flat-iron bases, car grilles, rustic chandeliers, spray guns, sweeper accessories, tubular furniture, various car accessories and costume jewelry.

Since many plating shops operate in conjunction with or under similar management with a foundry and polishing set-up, some of the important factors of these operations which affect good plating are briefly mentioned. The case history of the item to be plated is important. This is especially true of aluminum castings. The plater of polished metals, whether they be zinc, steel or brass, is conscious of the fact that aluminum should be no exception and should also be smooth and bright after plating.

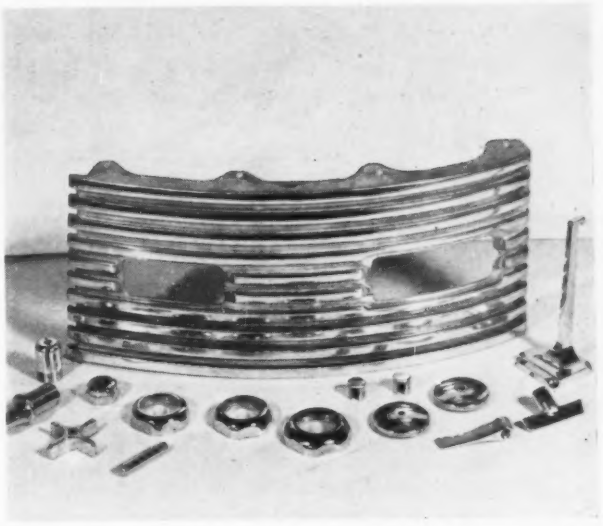

Figure 1. Typical group of parts that have been successfully chrome plated, including sand castings, die-castings, extrusions, and stamped parts.

Foundry Practice and Successful Plating

Die Castings

Aluminum die-castings have a tendency to be somewhat more porous than zinc die-castings. This porosity is due to several partly-controllable factors. The solidification point being higher than zinc naturally means that larger gates are required and that ample sized headers and bleeders be provided. The former is to insure a rapid delievery of hot metal, the latter is to provide a dead end for the oxides, nitrides and hydrides of aluminum outside the casting proper.

It is important to the plater that his aluminum die cast supplier furnish castings with a uniformly smooth surface. All die cavities should be thoroughly blown at regular intervals. The ensuing polishing operation after casting, unfortunately, does not always reveal the true surface conditions. All polishing operations, other than electrolytic means, tend to smooth over porous surface conditions. When the plater subjects such castings to strong alkaline cleaners and acid dips, some of these pores are reopened and will be visible after plating. Therefore, aluminum die castings should be rapidly cooled to produce a fine grained casting.

The cleaning specialists have been able recently to assist the plater, thus indirectly the die caster, by developing "non-etch" alkaline cleaners which do not rapidly attack polished aluminum castings.

Permanent Mold Castings

In the case of permanent-mold aluminum castings, the ingates and risers should be of ample size, as in the case of die-castings. It is very important to follow the long established practice of gating castings so that they cool from the bottom of the mold upwards to the riser. The outer surface of the castings should be rapidly cooled so that a fine-grained "skin coating" of considerable depth may be obtained.

Various methods are employed, all of which help to accomplish the same thing. Water or air-cooled molds are sometimes used, the more rapid cooling being directed towards the bottom of the mold. Various mold washes, some containing chlorinated compounds are employed. The function of the chlorine, or other halogens, is to surface-cool only. The release of halogens and their instantaneous combination with other elements at the mold surface is accompanied by absorption of heat. This causes rapid cooling and checks surface metal grain growth.

The mold face should always be sprayed carefully with extra fine ingredients. The talc, graphite, kaolin, etc., should be sprayed under moderate pressure and all signs of spalling and cracking after usage should be recognized and corrected.

It is important to the polisher and plater that such articles as flat-iron bases, door-knobs, juicer parts, washing machine spinners, and the like be cast under conditions which will impart surface smoothness.

Sand Castings

Aluminum sand-castings are inherently somewhat porous due to the chemical affinity of the base metal to oxygen, hydrogen, and nitrogen during the melting and cooling period. Other factors are also involved, such as trapped air and steam.

Sand castings cool slowly and with only pressure due to gravity. Unless special precaution is taken, this type of casting will have not only fine, gaseous surface porosity, but also core blows, sand holes, cold shuts and the like. These discrepancies present themselves more readily if they are polished and plated. On rough, sand-blasted castings they are not so discernible.

Certain remedies are available. For example, a chlorinated rubber in solvent solution, when used as a core and mold spray, helps to eliminate surface imperfections. The release of chlorine from this rubbery film takes place below the melting point of aluminum. The nascent chlorine not only cools the casting surface but serves as an excellent scavenger to form volatile hydrogen chloride gas. The reaction is produced solely by heat, the energy of volatilization being furnished by the incoming molten metal.

The foundryman can also help supply the polisher

and plater with fine grained castings thru the use of grain refiners. A small amount of 10% Titanium—90% Aluminum Alloy added to the small pouring crucible will impart a particularly fine grain if the pouring-time interval is short. The titanium oxidizes to TiO_2 which forms mechanical wedges between the grain and quickly discourages excessive growth.

Polishing and Buffing

CASTINGS

There are several commonly-known procedures for polishing and buffing aluminum. Most recommendations are made without consideration being given to the plater. This is only natural, since polished aluminum in the past has not generally been plated.

The usual polishing methods such as greasing with belts or wheels using grease-base polishing compounds is not suitable for the general run-of-the-foundry castings that are to be plated.

For example, a practice of using a 220 emery belt with a suitable oil, which does not load up like a solid lubricant, has proven highly successful. This operation is followed by a wheel operation wherein greaseless compounds are used. The castings should be immediately submerged in a high flash-point solvent followed by degreasing in a vapor type unit. The color-buffing operation is best performed using a "dry" greaseless compound, because any porosity that may exist on the original aluminum surface due to improper casting or excess greasing, machining, or "skin" destroying operations will not become embedded with caked, greasy solids. The heat created during a severe greasing operation and the surface pressure of the buffing operation, especially if done on automatic machines, causes grease type compounds to quickly dry in any porous area. The plater may successfully coat these minute pores but eventually blistering may develop under the plating.

EXTRUSIONS AND STAMPINGS

Considerable quantities of extruded aluminum tubing, round or hexagonal, requires electroplating as the final finish. Often this type of material will have fine longitudinal scratches in the surface which, while not too visible in the as-extruded state, will show up plainly after bright plating.

The material may be polished as recommended under "Die Castings." However, since tubing is thin, heat cannot be dissipated readily and warpage may occur. One would be hesitant to predict this as a result of automatic polishing. It has been found that relatively short lengths of hexagonal tubing, such as that used for towel bars and lavatory legs, will warp from the end pressure of holding jigs. A water-base liquid polishing compound is desired over a grease type liquid compound in the case of tubing. This eliminates smudge and fire hazard.

The fine scratches can be removed by polishing away the base metal. Perhaps an easier way to acquire the same results is to plate the base metal with a heavy coating of copper and color-buff before nickel and chrome plating. This requires a double racking operation for the plater but presents a much easier job for the polisher.

Stampings may be handled in the same manner as extrusions, but the problem of deep scratches is usually not present. Rolled material in stamped form can readily be polished and buffed on an automatic or semi-automatic machine. As in the case of other metals, irregularly shaped parts of the stamping may be finished by a hand polishing operation.

Ball Burnishing

Many aluminum castings and small stamping do not require a mirror finish after plating. Such items as slip-joint nuts used on the J and L bends underneath a lavatory, where corrosion protection only is desired, need only be ball-burnished smoothly and plated. Plumbing supplies, such as small key handles, open wheel handles, solid wheel handles, etc., may require a bright brass finish or a copper-nickel chrome finish but not necessarily mirror-like.

The usual procedure after die casting or stamping is to ball burnish in lined barrels using small steel shot in soapy water. The time required is dependent on the type of article and the amount of feathers, flashings, or burrs to be removed. Rather than wash the finished items in solvent and vapor degrease, it is advisable to warm water rinse and follow with a quick dry. Thus the castings are void of any soapy or oily film and if plated soon after burnishing little difficulty will present itself in the cleaning, etching and pursuant plating operations.

This method of brightening is the most ideal and, if suitable to the user of the plated articles, it should be used whenever possible. The field of ball burnishing aluminum is being rapidly explored and, to the writer's knowledge, has gone so far as to smoothly burnish large, sharp-edged pieces by racking them and placing the racks in barrels. Thus the danger of surface nicking is eliminated. By having various barrels employing different media, the racks are transferred from the coarse barrels thru to the finest.

Cleaning

DEGREASING AND PRESOAKING

As described above, articles may either be polished and buffed, or ball burnished. Polished items may be vapor degreased prior to racking or they may be treated in a soak cleaner after racking if vapor degreasing facilities are not available. A combination of the two is desirable, the former being preferred. Ball burnished items need neither.

The soak cleaner can be any one of several types recommended by detergent manufacturers. In any case, they should be of the "non-etch" variety. A few minutes soaking at 170° to 180°F. is usually sufficient to loosen any stubborn foreign material. It is important to note at this point that if proper precaution is exercised in the polishing shop the amount of polishing

material left on the item should be at an absolute minimum.

Alkaline Cleaning

There are several kinds of "non-etch" cleaners available. Those which have been tried in production have all worked satisfactorily on freshly ball burnished material. However, it has been found that on polished and buffed material, some "Non-etch" cleaners are too mild, even when carried in fairly high concentrations and at temperatures near 200°F. A combination of "non-etch" and "etch" type, allows one to secure a very slight white etch on pure aluminum sand castings or stampings, or a slight discoloration on copper-silicon-aluminum alloy die-castings.

If a straight "etch" type cleaner is used at 160°F. with 5 oz. per gallon content, the cleaning cycle has to be short, but it requires a very dense surfaced casting to withstand even this. The longer the cleaning cycle, the heavier the etch becomes, and if polished beforehand, the bright platings that follow will surely reveal over-etching.

A good practice on ball burnished items is to clean chemically in the alkaline cleaner until gassing starts. After five seconds of gassing sufficient etch is obtained to insure cleanliness and still not impart dullness after plating. On polished items, the first indication of uniform gassing is sufficient and the work should be removed at once.

In no instance should aluminum items be allowed to be cleaned in a zinc cathodic cleaner, if the latter is to be used again on zinc, for eventually severe blistering will occur on the zinc.

Rinsing

Many parts contain recesses, cavities, threads, etc. Extreme care in rinsing is probably more important than in the case of other metals, for aluminum is inherently more porous. Neutralizing baths are advisable.

All rinse tanks in the plating set-up should be equipped with high pressure fan-type sprays. A good type is illustrated in Figure 2.

The lower body of water in the rinse tank proper is kept warm with open type heating, such as small (3/32") holes spaced about 1" apart. The condensate is always clean, and rapid and efficient heating is obtainable in the tank.

The standpipe opening can serve as an overflow and with a few small holes drilled near the bottom of the pipe, clean water is always assured. The former floats off surface films while the latter assures complete water replacement. Thus the racks emerge into warm water, are thoroughly agitated therein and finally raised slowly thru the curtain of cold water produced by the fan type spray. This procedure should be followed at least twice between all steps of cleaning and plating.

Pickling

There are several recommended procedures for pickling aluminum, such as anodizing in phosphoric acid, chemically treating in strong nitric-hydrofluoric acid mixtures, etc.

A highly successful practice used over a period of fifteen months in one plant has produced no plating rejects due to unsatisfactory pickling. The bath contains neither nitric nor hydrofluoric acid and is operated at less than 15% acidity. The work is made cathodic in the bath which operates at room temperature. A very high current density is used which produces a tremendous evolution of hydrogen. The mechanical scrubbing effect of this gas, plus the non-passivating effect, seems to assure 100% reception of chemical zinc from a sodium zincate bath or an electroplate if transferred directly to a nickel or chrome bath. Special precaution prior to direct plating must be observed, however, as hereinafter described.

The nitric-hydrofluoric pickling baths can be diluted to suit the item being treated but at best they are obnoxious, and require carbon-brick lined tanks. (Lead-lined tanks, carefully hot-waxed (parafin and beeswax) with several coats and pressed compactly with a hot iron, failed after a few weeks operation.)

A mild acid cathodic bath will operate practically indefinitely with small additions to take care of drag-out and slow electrolytic break-down. Operated cathodically, very little rise in Baume is discernable, since the electrolytic treatment forces no metal into solution.

Chemical Zinc Coating

The immersion zinc-coating method has proven highly successful. It is somewhat expensive to buy in prepared salt form. This can be partly overcome by preparing the bath using caustic soda and zinc oxide. Considerable heat is generated when the caustic is dissolving and solution temperature should be checked after each sizeable addition. The zinc oxide can be added after the near-saturated solution of caustic is made up. A Baume of 40° at room temperature is desirable altho the bath works satisfactorily at concentrations considerably lower. Upon re-cooling, the bath is in good condition. If the level is to be raised it should then be done with correct proportion of chemicals and allowed to cool before using again.

A steam coil should be installed in this bath. Shops set up to plate various types of base metals in the same monorail line will find that water drippage, unless the tank is covered, will eventually dilute the zincate bath. A steam coil allows for evaporating down to original concentrations and will re-dissolve most accumulations in the bottom.

There are no fumes or critical immersion times involved. No generator is required. Workers should be cautioned in regard to the solution's corrosive effects on clothes and skin.

Polished castings require longer immersion times than ball-burnished castings. The alloy also has a bearing on the time required for the complete zinc film to form.

The relatively pure aluminum alloys of the 2S and 3S types require very little time. Good plating results have been secured by merely dipping the racked material for two to five seconds. Alloys such as 52S require a longer immersion time and it is advisable to

Figure 2. Spray rinsing of parts after cleaning operations is recommended for best results with aluminum alloys.

have an insulated work bar over the tank on which racks can be hung for a minimum of one-half minute. The 17S and 24S types of alloys require the longest period of immersion. Ball burnished items will receive the zinc coating in approximately forty-five seconds while polished items require one minute.

The chemical reaction stops when the zinc displacement has taken place over a whole area of the work. It is important to provide some agitation to the work. Still tanks should be provided with either a work rod mover or an air agitator.

This solution is very viscous and ample time should be allowed for drainage. The sodium hydroxide content will also cause considerable floc in the rinse water as it displaces the magnesium and calcium content of the same. Ample free flowing water in the rinse tank following the zincate dip is a must, and a double rinse tank is recommended.

A direct transfer after rinsing to nickel or chrome has been tried with some success. However, most automotive and plumbing specifications specify a copper coating. This is done in two plating operations as described below.

The aluminum to be plated is most sensibly considered at this point to be a zinc base metal. The sodium zincate bath chemically produces a zinc "skin" upon the surface of the aluminum. The thickness of this skin is approximately .0000026" thick.[1]

Plating

The First Copper Deposit

Normally, the next step is to deposit a light coating of copper in a Rochelle Salt copper bath. The usual composition of two to three ounces per gallon of copper metal is satisfactory. Sufficient sodium cyanide must be present to dissolve all the copper cyanide, but the excess or "free" cyanide should never be allowed to exceed 0.75 oz./gal. The caustic content of the bath, imparted by the sodium cyanide and a small addition of caustic soda, should be fairly low. A colorimeteric pH of 10.5 is optimum. Caustic soda additions are preferable to sodium carbonate.

Any small chrome contamination in this bath will lead to severe blistering. Periodic additions of one ounce of Sodium Hydrosulphite (disssolved in hot water) to 100 gallons[2] of Rochelle bath should be made, especially if the same racks are used through all the plating baths. Baths containing no Rochelle Salt do not require so frequent additions as those that do.

The voltage can be mainained at 6 to 7 with a Current Density of at least 40 ASF. Aluminum with a thin coat of chemical zinc should be plated as quickly as possible. A temperature of 140°F. has worked satisfactorily.

Commercial brighteners containing Rochelle Salt are satisfactory and can be added to a regular cyanide copper solution. No objectionable effects have been noted on the chemical zinc coating.

The Second Copper Deposit

Because of the plating inefficiency, dullness, and general character of deposits from conventional cyanide flash baths, a second or high-speed copper deposit is desirable.

Any type of bright copper generally employed on zinc-base items is satisfactory. The pyrophosphate type is particularly good if buffing is to be done after copper plating as the bath contains no brighteners to harden the deposit. It is mildly alkaline and easy to control. The throwing power is exceptional, which is important on hollow or recessed portions. Aluminum contamination in certain bright nickel baths is undesirable. Some items such as aluminum tubing, if

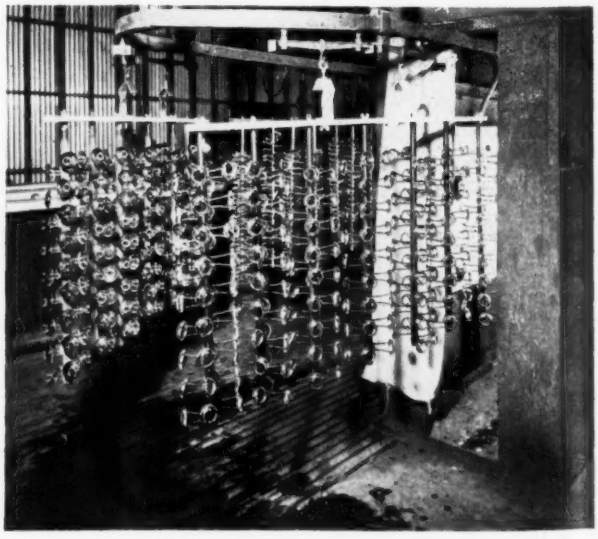

Figure 3. Multiple racking of parts for economical and efficient handling on overhead conveyors.

Figure 4. Racks are made interchangeable for many production jobs simply by changing spines, a matter of a few minutes time.

not properly coppered at this point will cause gassing and dissolution in the bright nickel bath.

Electropolishing the Second Copper Deposit

Heavy copper-plated aluminum items can be electropolished in various solutions, principally those with phosphoric acid as a base. This can be accomplished as a plating step prior to the bright nickel deposit, but there are several disadvantages to the process which rather overshadow its advantages.

1) Concentrated acid must be used; this spells high drag-out losses and high initial make-up cost. 2) There must be no cavities or abnormal depressions, since the reverse throwing power of the electropolishing bath is different than the direct throwing power of the plating bath. 3) Hollow castings tend to cause considerable gassing at holes and key-ways which cause shading and streaking. 4) High currents must be used (2 to 3 ASI), which makes the installation and operation costly. 5) Passivation of the copper plate also occurs which causes blistering of any following electroplate unless an intermediate step is taken. The de-passivating may be done chemically in hot sulphuric acid or cathodically in a mild alkaline solution.[3] The former is not recommended on hollow items such as towel bars, bath spouts, lavatory legs, etc., as the hot acid will cause considerable attack on the unplated interiors. The latter is satisfactory on this type of material, but a very thorough rinse in a mild acid bath should be used to avoid contamination of the alkaline solution with the bright nickel bath.

Electropolishing does produce lustre on copper plate, but unfortunately it does not hide surface defects and will never replace mechanical polishing, unless die casting and fabrication are perfected to a greater degree.

The Bright Nickel Deposit

Most plating departments are set-up with bright nickel solutions of the low pH type. These baths are maintained hot (130°-140°F.). Aluminum tubing, which is not copper coated inside, will be chemically attacked in such baths unless the pH is carried high (4.2 to 4.4 colorimetric). The usual pH of 3.5 can easily be raised by packing the filter with nickel carbonate and circulating the solution until the desired pH is reached.

Solid aluminum castings or closed stampings can be satisfactorily plated in the above solutions at the lower pH. If all exposed surfaces are adequately coppered, the aluminum item will nickel plate as easily as any other base metal.

Aluminum has been successfully nickel plated without either a chemical zinc coating or a copper plate. This procedure is accomplished by maintaining a high nickel pH, as mentioned above and impressing current to the racks before submerging them in the electrolyte.

The Chromium Plate

After nickel plating, the aluminum items can be chrome plated in the usual manner. A Baumé of 27 to 31.5 with a 100:1 ratio of chromic acid to sulphate radical works satisfactorily. A bath temperature of 90°F. gives good results.

Chrome can also be applied directly to aluminum by impressing a current density of about twice the magnitude of ordinary methods.

The zinc-copper undercoating has proven the most reliable of the above methods.

Removing Aluminum from Nickel Baths

Aluminum contamination in a bright-nickel bath cannot be "dummied" out. The general procedure is to carefully raise the pH to 4.5 with lime water, proceeding to a pH of 4.8 with nickle carbonate. This is carried out in a storage tank at 160°F. with thorough

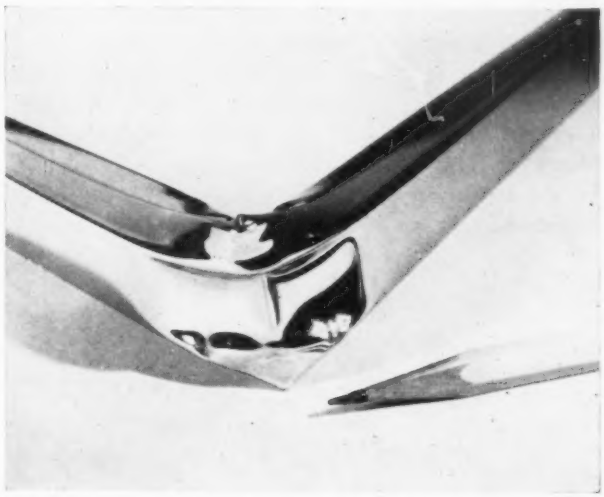

Figure 5. The excellent adhesion of electrodeposits over aluminum is illustrated in this bent sample. This part has .0003" of copper under .001" of nickel, followed by a thin chrome flash coating.

agitation. At the pH of 4.8 potassium permanganate is added, using eight ounces per one hundred gallons of nickel solution. Other metallic contaminations besides aluminum are precipitated simultaneously. Sulphur-free carbon can be added also to eliminate organic matter. After 1 to 2 hours, the solution is filtered back to the plating tank. The pH is then adjusted to operating range.

If work is transferred from the zincate bath directly to the bright nickel bath there is some zinc contamination possibilities. This can be removed by lowering the pH to its lowest point of the workable pH range and the zinc can be "dummied" out on large corrugated steel sheets at 2-4 ASF. (Some tanks are provided with a continuous zinc removal tank.) The zinc contamination becomes noticeable when its concentration reaches 0.05 gm./l., when foggy deposits will appear in the low current density areas of the work. At approximately 0.08 g./l., brittleness will manifest itself. The nickel-zinc co-deposit can be easily recognized on a Hull Cell panel where actually additions of zinc to the nickel solution can be made and results observed.

The Use of Aluminum Racks

Aluminum (2S) has a conductivity 57% as high as pure annealed copper.[4] By increasing the cross-sectional area of the spines by about 40%, a conductivity equivalent to pure copper is obtained. The net savings in weight of racks is appreciable. Where multiple racks are used, such as 6 spines with a cross-piece, a $\frac{7}{8}$" x $1\frac{1}{2}$" 2S aluminum bar will carry approximately 600 Amps and will deliver 100 Amps to each spine with no noticeable voltage drop. This is based on the assumption that 1 sq. inch of copper conductor will safely carry 1100 to 1200 Amperes.

The important factor governing the type of rack metal depends on the type of pickling bath used prior to plating. If nitric-hydrofluoric acid is used, the racks should be constructed entirely of aluminum, using 24 ST contacts in place of phosphor-bronze. This type wire or ribbon in aluminum, however, is brittle and easily broken. Phosphor bronze wire gives the plater a more versatile rack which can be used for a variety of items. The use of a cathodic mild acid pickle as outlined previously enables one to use phosphoric bronze wires for contacts. Therefore, if a shop is plating metals other than aluminum, chances are the racks on hand are of this type and special aluminum racks would not have to be made up.

A view of a successful and versatile multiple rack is shown in Figure 3. The spines are easily removable by using a $\frac{3}{8}$" stud and wingnut. A speed-wrench and tool for cleaning the top of the spine and the underface contact of the aluminum crosspiece can be used. This member is drilled on center longitudinally with oversize $\frac{3}{8}$" holes, 1" apart. By so doing, the number of spines per cross piece can be varied according to the type of material to be plated. Thus a few cross pieces with copper hooks can be made up and will accommodate a great number of various types of spines. By drilling and tapping the top of the spine, and inserting a $\frac{3}{8}$" stud, all racks can be made interchangeable. See Figure 4.

The racks are carried from one tank to another by a simple monorail hoist. The hoist speed on the cleaning cycle should be such that racks can be quickly raised and transferred. Hot alkaline cleaners continue to react on aluminum and a fast water rinse is advisable.

The racks need not be subjected to any acid dips between unracking and racking stations. If coatings on the racks are carefully applied and contacts trimmed properly, rack coatings will last for many months. Thus chrome carry-out is neglible. If the aluminum items being plated adequately cover the trimmed rack contacts, stripping metal build-up can be done only as required.

One of the best solutions for stripping aluminum contacts is 75% phosphoric acid, with reverse current. The bath is essentially an electropolishing bath and will, at high current density, remove chrome, nickel, and copper very efficiently, leaving a smooth, bare aluminum contact on the spine of the rack. A 24 volt generator or rectifier is required. If phosphor bronze contacts are used then the stripping bath should be void of phosphoric acid. A 60% sulphuric acid solution is recommended in this case, using reverse current.

Salvaging Plated Aluminum Items

One of the finest salvaging operations for removing defective chrome plate on nickel-plated aluminum, or other base metals, can be done in the above aluminum rack stripping solution. The 75% phosphoric bath will remove chrome very fast and produce a high lustre on the nickel plate, and is operated at a minimum of 2 ASI. The passive surface can be treated as previously mentioned under electropolishing. If the nickel deposit is defective it too can be removed, leaving an electrolytically bright copper base. This is true providing the contour of the work is not intricate.

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A Semi-Bright Nickel Plating Process

By Karl S. Willson and A. H. DuRose, *Harshaw Chem. Co., Cleveland, Ohio.*

Recently developed on a commercial scale, a new semi-bright nickel plating process yields a deposit of modified crystal structure. Characteristics of this deposit are its semi-bright luster, its good buffability and its unusual property of filling-in surface irregularities. Operating features of the bath, and its advantages and limitations are discussed.—Ed.

EVER since the first commercial gray nickel deposits were produced several decades ago, research workers have been endeavoring to secure improved deposits having desirable characteristics such as brightness in the "as plated" condition, easy buffability, good covering power for surface imperfections, improved throwing power and good bright-throwing power, ductility, and moderate hardness without brittleness. The plating bath should possess inherent stability, be moderate in cost, and not too susceptible to operating variables or the effects of metallic or other impurities.

Until recently, it had been believed that a choice existed largely between the gray nickels, and the fully bright nickels. Where the base metal was sufficiently smooth, or where the application was such that magnifications of base metal imperfections were not critical, the bright nickel baths have provided a highly suitable deposit in many applications.

In the case of certain large steel parts, such as automobile bumpers, the high cost of preparing smooth base material, and the difficulty in buffing bright nickel in those cases where the base metal was not properly finished, have discouraged the use of bright nickel for such applications. In these cases, gray nickel baths have been used and relatively heavy deposits of nickel applied, with a considerable amount of the nickel plate being subsequently removed in the buffing operation necessary to secure a smooth, bright finish.

Comparatively recently, a third choice has been added to the types of nickel deposits available to the industry. This newest addition is an easily buffed, semi-bright deposit which combines many of the desirable characteristics of both gray and bright nickel.

Smoothing Effect

Outstanding among the properties of this nickel bath is the ability of the deposit to fill-in base metal imper-

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fections. This "scratch-filling" or "smoothing" effect has been reported previously for other solutions[1] but these solutions exhibit the effect to a markedly smaller extent than is the case with the new bath. Typical photomicrographs (Fig. 1) show the remarkable filling-in of an imperfection. Previously published data compare this new process with other nickel deposits[2]. Because of the ability of this new process to fill in scratches and polishing marks, certain final steps in the preparation of the base metal prior to plating can be eliminated. The resulting savings in finishing wheels and compounds are coincident to the important savings in labor and in the reduction in metal finishing equipment.

Buffability

Unlike gray nickel, the deposit requires only a light pressure on the color buffing wheel to bring out full brightness. Quantitative data were published[2] and subsequent data secured on a machine similar in principle to the unit cited confirm the comparatively low drag on the buffing wheel. The quantitative buffing machine (Fig. 2) applied a fixed pressure on the buffing wheel by means of air pressure on the cylinder as illustrated. The moveable table on which the panel is shown registered drag by pressure against a hydrostatic bellows, or on subsequent modified equipment, against a calibrated helical spring. In a typical comparative test, drag registered against the hydrostatic bellows was as shown in Table I.

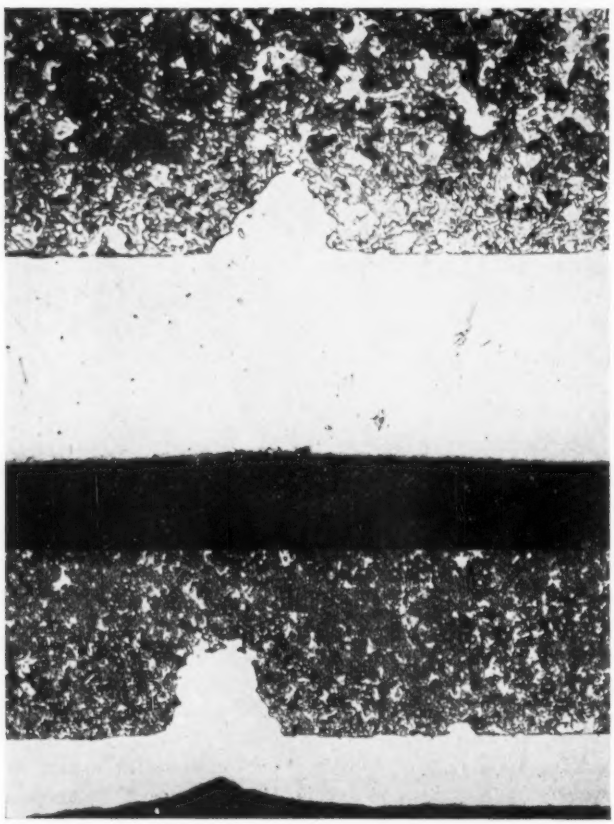

Figure 1. White area represents cross section of semi-bright nickel plate filling in surface depression in steel panel (gray area). The photomicrograph with the thicker nickel deposit shows the progress of the smoothing phenomenon.

Table I—Drag

Pressure on Panel 5 pounds per sq. in.
Drag as pounds per sq. in. registered on bellows.

Semi-Bright	Watts Type Gray
.5	2.0
.6	2.0
.6	1.8
.5	1.9

The deposits have been found to be well suited to electrobuffing techniques, but as with other types of electrobuffed nickel deposits, a "bloom" sometimes develops during chrome plating[3].

Hardness

Deposits are intermediate in hardness between gray and bright nickels. Results secured on a Tukon tester show a considerable range of values as shown in Table II. Unfortunately, the same samples were not used for surface and cross section tests.

Table II—Hardness

TESTS ON CROSS SECTION READINGS AT CENTER OF PLATE—

(Long direction of diamond parallel to base metal)

		Knoop No.
Bright	Test Series 1	547-593
	" " 2	507-593
Semi-Bright	" " 1	275-308
	" " 2	327-423
TESTS ON SURFACE		
Watts Type	Test " 1	194
	" " 2	124-179
Semi-Bright	Test " 1	355
	" " 2	245-346
Bright		599

Stress

Stress in a deposit from the new bath is similar to that of a gray plate from a Watts type bath. Impurities tend to increase the stress but means are available for restoring the stress to normal. Tests were made using equipment similar to that described by *Phillips* and *Clifton*.[4]

Corrosion Resistance

Panels and parts, both in salt spray and field tests, indicate that these deposits provide corrosion resistance comparable with deposits from other satisfactory baths. The effects of impurities are similar to those of other related baths.

Tensile Strength

It has been reported that tensile strength of sound nickel deposits from this new bath varies from as low as 100,000 to as high as 240,000 pounds per square inch, depending on variables in the operating conditions.

Operating Conditions

The semi-bright bath is based on a Watts type solution with nickel sulfate customarily at 40-45 ounces per gallon. Lower concentrations are possible but decrease conductivity. Nickel chloride and boric acid are usually held at 6 ounces per gallon, although higher concentrations of nickel chloride can be used satisfactorily in some applications.

At the present time, operating temperature of the bath is ordinarily in the range 120-135° F. Higher temperatures may be desirable in some applications, but specialized equipment is necessary due to physical properties of the addition agent.

Because of the limited solubility of the addition agent used in this plating bath, this agent is not added directly to the bath, but is customarily charged into a suitable filter thru which the plating solution is circulated. If the bath temperature is above 140° F., the solution must be cooled before entering the filter to prevent melting of the addition agent unless small frequent additions are made. The operating bath is controlled by analysis to maintain a concentration of 0.75 to 1.0 pounds of addition agent per 100 gallons of solution in most applications. Additions are made by charging the material into the filter hourly in some instances, once per shift in others.

The operating pH of the bath is maintained in the range 3.5-4.5 by periodic addition of sulfuric acid.

Because of the wide range of concentration of all materials making up the bath, control of the solution is simple.

Filtration Requirements

Because of this intermediate pH range, ferric iron tends to more or less continuously precipitate in the bath. It does not readily settle to the bottom of the tank as a sludge, however, since introduction of the addition agent via the filter necessitates frequent if not continuous turnover of the solution. As a result, it has been found imperative that practically continuous filtration be used at a rate equivalent to complete filtration of the tank every one to two hours depending somewhat on the size of the tank and operating variables. This filtration provides adequate turnover of the solution and is cheap insurance against roughness and other difficulties.

Effect of Impurities

As with all nickel baths, metals such as iron, copper, zinc, etc., and organic materials, may cause increase in stress and reduction of luster in low current density areas, and metallic impurities should be maintained at limits similar to those for other nickel baths. Care should be taken to remove dropped parts from tanks immediately since such parts not only add metallic impurities, but in the process of dissolving may affect the addition agent.

Figure 2. Standard machine for testing buffability of deposits.

Purification

For removal of metallic impurities, such as Cu and Zn, electrolytic purification treatment has proved helpful in several installations. Where chemical treatment is desired to reduce both metallics and organic materials, use of hydrogen peroxide, activated carbon and high pH in various combinations have proved successful. Such treatment will restore the solution to the original Watts type bath.

Costs of Operation

Because of variation in drag-out losses between types of work being plated, the rate at which impurities are accumulated necessitating more or less frequent purification, difference in operating conditions from plant to plant, etc., it is difficult to arrive at a precise cost for operating this new solution. In general it may be considered to be of the same order of magnitude as the cost for operating a standard bright nickel solution when bare plating costs alone are considered. When over-all finishing costs are taken into account, large savings on materials and direct labor for polishing and buffing result, in those cases where the use of the bath finds proper application.

Semi-bright nickel is not a panacea for all the troubles of the plater, but it is opening new possibilities of improved finishes in a variety of applications.

ACKNOWLEDGMENTS

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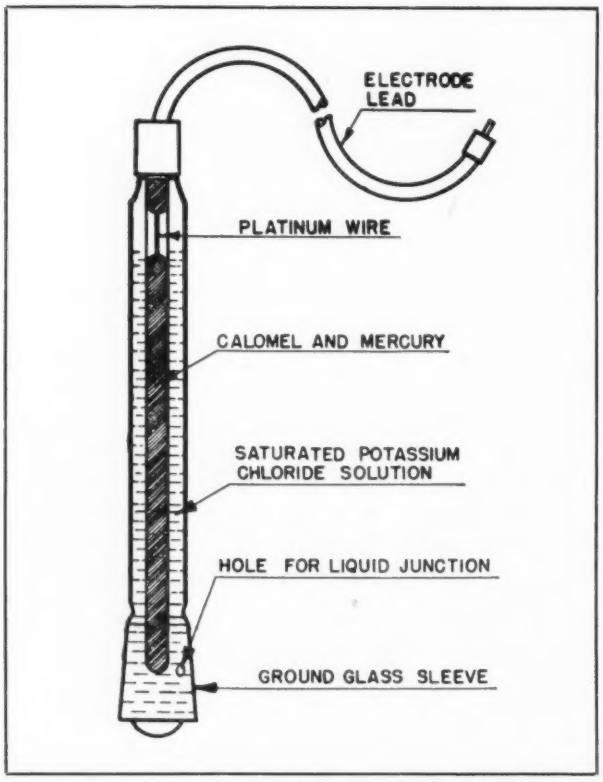
pH—Its Meaning and Determination—Conclusion

By Howard Sanders, *Calco Chem. Div. of American Cyanamid Co., Bound Brook, N. J.*

THE previous article (January, 1949, *Metal Finishing*) dealt with methods of measuring pH colorimetrically. But this was only half of the story. Of equal or even greater importance is the electrometric method of analyzing for hydrogen-ion concentrations. Not only is this technique more accurate, but electrical pH measurements overcome the barriers to accuracy caused by the presence of color, turbidity, or foreign matter in the tested solutions.

In addition, electrometric methods of pH measurement make possible the use of auxiliary equipment for the automatic control of baths, a very important practical consideration.

In the electrometric method of analysis, pH is determined by measuring the voltage developed by two electrodes in contact with the solution. A single electrode potential cannot be measured without a second electrode to complete the electrical circuit. The total potential developed is the algebraic sum of the two electrode voltages. The potential of one of these electrodes, referred to as the reference electrode, is known and remains constant. Hence the net potential is solely a function of the voltage generated by the other electrode. For proper analysis, the voltage of this measuring electrode must depend only upon the pH of the test solution. Provided the limitations of the electrode are taken fully ino acount, the potential developed is a direct index of pH. A wide variety of measuring electrodes are available, but three stand out as being among the most useful: the hydrogen, the quinhydrone, and the glass electrodes.



(*Courtesy Beckman Instrument Co.*)

Figure 1—Calomel electrode with ground glass sleeve.

Reference Electrodes

Hydrogen Electrode

Just as geographical elevations cannot be measured without reference to some specific elevation such as sea level, arbitrarily given the value of zero feet, so electrode voltages must be measured with respect to some special standard of voltage. The hydrogen electrode serves as this primary reference standard. Since single electrode voltages cannot be measured, all electrode potentials are defined as their potential with respect to the hydrogen electrode, which is arbitrarily assigned the value of 0.000 volts. However, since the use of a hydrogen electrode requires a relatively large amount of equipment and laboratory skill, it is employed on a commercial scale only to a very limited extent, although its principles of operation are basic to all electrometric measurements.

Hydrogen gas does not conduct an electrical current and hence cannot be used alone. However, when absorbed on the surface of an inert metal, which does not enter into the reaction but acts merely as a conductor, the gas behaves exactly like a metallic electrode. Basically, the hydrogen electrode consists of a piece of inert metal, such as gold or platinum, covered with platinum black, a form of metallic platinum which conveniently provides a larger surface for gas adsorption than the ordinary form of the metal. Hydrogen gas is adsorbed on the surface of the platinum black by continuously bubbling the gas around the electrode at one atmosphere of pressure. The electrode is immersed in the solution under test and connected to a reference electrode having a fixed and known potential.

Calomel Electrode

As is common practice, a calomel cell is employed as the reference electrode. It consists of pure mercury in contact with a mercury and mercurous chloride paste. Connection between the electrode and the test solution is sometimes made through a salt bridge, which is a glass side arm filled with a solution of potassium chloride in direct contact with the mercury cell and with the test solution. More generally employed than the salt-bridge type of calomel cell is the more compact electrode which makes connection with

the test solution via a loosely fitting ground-glass joint, which permits free passage of the current but minimizes the diffusion of the potassium chloride into the test solution. A diagram of this type electrode is shown in Fig. I. In either case, electrical connection to the outside circuit is provided by a platinum wire in contact with the mercury at the base of the cell.

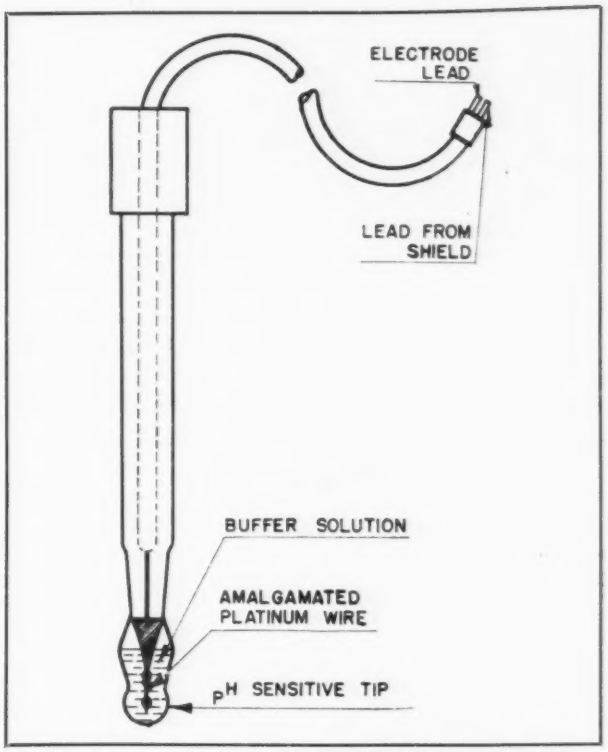
The voltage of the hydrogen and calomel electrode combination is measured by an accurate potentiometer and this, in turn, indicates the pH of the solution. Using the hydrogen electrode, accuracies of plus or minus 0.01 pH may be obtained. Generally speaking, however, this sensitivity, while sometimes extremely useful, is greater than the ordinary industrial requirement demands.

Measuring Electrodes

Quinhydrone Electrode

The hydrogen electrode described above can also be used as a measuring electrode, but since the hydrogen electrode is difficult to prepare, is readily poisoned, and cannot be employed in solutions which react with hydrogen, other, more serviceable electrodes have been devised to replace the hydrogen electrode in commercial measurements. One of the recommended electrodes uses quinhydrone for the measurement of pH. Quinhydrone is a mixture of an oxidizing agent, quinone, and a reducing agent, hydroquinone, in equal molecular concentrations. Hydroquinone is thus essentially the reduced form of quinone. The mixture is added directly to the solution being tested for pH. About six to eight drops of a saturated solution of quinhydrone in acetone is recommended for 50 cc. of solution, although quinhydrone powder in its pure, crystalline form may be added directly to the solution. The quinhydrone electrode itself is actually nothing more than a well-cleaned piece of platinum or gold wire in contact with the test solution and connected through the external circuit to a suitable reference electrode. The pH of the unknown solution is determined by measurement of the resulting voltage, exactly in the same manner as with the hydrogen electrode.

The inert wire placed in the test solution containing quinhydrone acquires a potential which depends primarily upon two factors: 1) the ratio of the hydroquinone to the quinone concentrations and 2) the hydrogen-ion concentration of the solution. However, if the concentrations of hydroquinone and quinone remain equal, their ratios remain equal to unity and hence the potential then depends solely upon the pH of the solution. Anything which disturbs the equality of hydroquinone and quinone concentrations impairs the accuracy of the pH measurement. Provided that equal concentrations of hydroquinone and quinone are originally added to the test solution, their concentrations will remain equal in solution if the pH is less than 8.5. In solutions of higher pH, the alkali reacts chemically with the quinhydrone, disturbing the equality of hydroquinone and quinone concentrations. The presence of strong oxidizing or reducing agents in the test solution similarly leads to unreliable results.



(Courtesy Beckman Instrument Co.)

Figure II—Glass electrode assembly.

Furthermore, the electrode cannot be effectively operated in strong salt solutions, which may cause nonuniform precipitation of the quinone and hydroquinone by the salting-out effect. Results with a quinhydrone electrode are usually about 0.05 pH higher than those determined with a hydrogen electrode. The difference in readings is caused by the "salt error" in the quinhydrone reading, the quinhydrone increasing slightly the conductivity of the test solution. Variations of this magnitude are often negligible.

The quinhydrone electrode is excellent for readings in the acid range of pH 0 to 7. It is simple and convenient to handle, is not easily poisoned, and develops its potential rapidly. Hence the cell may be used quite satisfactorily for the accurate control of pH provided that proper attention is paid to its basic shortcomings.

Glass Electrode

The most practical electrometric device for measuring pH is the glass electrode. In convenient, portable units of high sensitivity, it is widely used for analytical research and industrial control. The electrode requires no hydrogen gas and no quinhydrone mixture. In fact, no chemical ingredients whatever need be added to the test solution. This is an important advantage in many cases where the amount of sample is limited and other tests must be performed. The electrode consists principally of a glass surface in combination with a suitable reference electrode and voltage-measuring system.

More specifically, the glass electrode operates on the principle that when a thin membrane of suitable glass separates two solutions of different pH, hydrogen ions are adsorbed on both sides of the membrane, thereby setting up a potential which is a direct function of their hydrogen-ion concentrations. The hydro-

gen-ion concentration of the solution on the inside of the electrode is maintained constant by a buffer solution and hence the net potential is dependent solely upon the pH of the outside solution being measured. The glass electrode itself is a thin glass bulb at the base of a glass tube. On the inside of the tube is a reference mixture composed of silver and silver chloride. One commercial type is shown in Figure II. The glass electrode is immersed in the unknown solution, which in turn is connected through the external circuit to a suitable reference electrode, usually calomel. A highly sensitive instrument must be employed in measuring the resulting electromotive force since the voltages involved are extremely small due to the relatively high electrical resistance of the glass. A vacuum-tube potentiometer is frequently used.

Provided the temperature remains constant, the generated voltage is, within limits, a linear function of pH. For instance, if the temperature remains fixed at 25°C., the voltage changes 59 millivolts for each change of 1 pH unit. This relationship of voltage to pH is linear up to a pH of 9.6, above which the glass electrode may be used to a pH of 12.5 provided a special calibration is employed. Large departures from linearity are noted in solutions of high alkalinity, where potentials, although often reproducible, are no longer a function of hydrogen-ion concentration alone. Solutions having sodium-ion concentrations in excess of 0.1 molar also give trouble in this respect.

As compared with other pH measuring devices, the glass electrode has many important points of superiority. It is entirely suitable in the presence of oxidizing or reducing agents, which seriously limit other electrodes. No use need be made of a gas or other added material. Since very small electrodes are available, only minute amounts of unknown may be employed in the analysis of pH. Colored, turbid, or viscous solutions provide no hindrance to its effective operation. The electrode may be used in non-aqueous solutions and in many instances where other electrodes are totally inapplicable. The electrode insures the accurate determination of pH even in unbuffered solutions since the introduction of the glass does not disturb the pH of the test solution. Furthermore, equilibrium is attained almost instantly, thereby permitting quick determinations of pH.

Through the use of the glass electrode, automatic pH recorders and controllers have for the first time been made an industrial reality. High-temperature

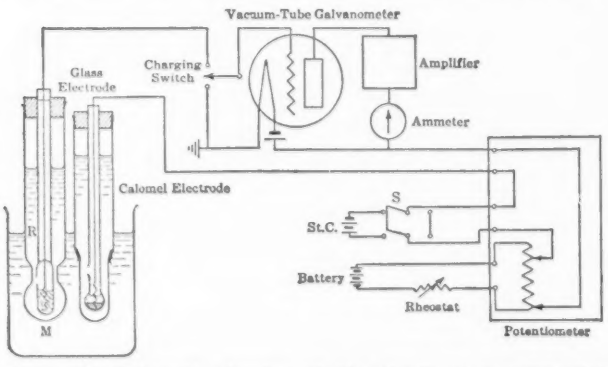


Figure III—Schematic drawing of the circuit of a commercial pH meter.

(*Courtesy Leeds & Northrup Co.*)

Figure IV—Glass electrode pH meter of the deflection meter type.

glass electrode equipment permits precise pH measurements at temperatures in the region of boiling water, normally a temperature zone of great inaccuracies. The bulb, employing glass of special composition, is designed to minimize breakage. Recent improvements in glass composition as well as modifications in the electronic circuits have given the electrode increased sensitivity despite the use of heavier and thus less fragile glass. The life of the electrode, in fact, is largely determined by the slow crystallization of the glass. Since the calomel electrode commonly used in conjunction with the glass electrode seldom requires replacement, the entire assembly is particularly suited for repeated use over long periods of time.

Despite these significant advantages, the glass electrode is subject to errors in solutions which are extremely acid or extremely alkaline. In the very alkaline region, the electrode gives readings that are too high. On the acid side, below pH 0, the meter pH value is greater than the actual pH, although these errors are frequently of small consequence.

Measuring Instruments

In one popular type of glass electrode pH meter, the hydrogen-ion concentration is read directly from a deflection scale. The potential of the electrode system, after suitable amplification, energizes an ammeter, which is calibrated to read directly in pH units. The use of a temperature compensator covering the range of 10° to 40°C. eliminates the need for temperature correction tables in this region. A typical circuit for this type of instrument is shown in Figure III, while Figure IV shows a commercial form of this type instrument.

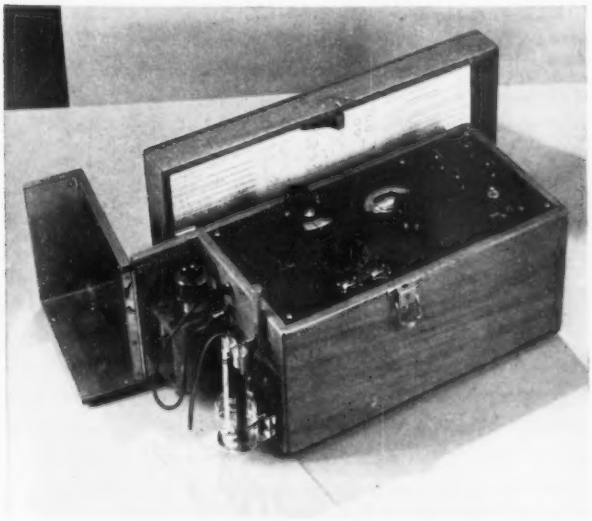
For greater accuracy, an instrument has been designed which employes a null-potentiometer rather than a deflection meter for the indication of pH. Accuracy is improved, since at the time the reading is taken there is no current flowing and the meter reads zero. In the null-potentiometer type meter, the voltage developed at the electrodes is connected directly in

TABLE I—pH RANGE FOR PLATING BATHS

BRASS and BRONZE (Cyanide)		
"High Speed Type"	12.0-12.5	12.25
Rubber Adhesion Brass Solutions	10.5-10.6	10.55
CADMIUM		
Cyanide	12.0-13.0	12.5
Bright	13.3-13.4	13.35
Fluoborate		5.4
CHROMIUM		
Ornamental	0.0-1.0	0.5
Industrial (Hard)	0.0-1.0	0.5
COBALT		
Cobalt-nickel		3.7
Simple cobalt plate		6.5
COPPER		
Acid bath	0.0-1.0	0.5
Rochelle Salt-Cyanide	12.2-12.8	12.6
Conventional cyanide	12.0-13.0	12.5
Immersion plating (acid)	0.0-1.0	0.5
Brass (mixed cyanides)	10.5-11.0	10.75
Brass (cyanide type)		9.0
Brass (70-30 composition)	9.4-11.0	10.2
Alkanesulphonic acid bath	1.0-1.25	1.13
Pyrophosphate-ammonia bath for aluminum plating	7.2-7.8	7.5
Acid-sulphate	3.2-3.8	3.5
MacDermid high speed bright plate	13.0-13.5	13.25
Plating of aluminum		8.5
GOLD		
Cyanide	Over 12.0	
INDIUM		
Fluoborate		1.0
Sulphate		1.8
Cyanide, high pH		11.0
IRON		
Hot chloride No. 2 (Ferrous-calcium chloride)	0.6-1.0	0.8
Room temperature chloride (Ferrous-potassium chloride)	5.0-5.5	5.25
Modified sulphate for stereotypes	3.5-5.5	4.5
Sulphate-chloride (stereotypes)	3.5-5.5	4.5
Sulphate-chloride (wax and lead molds)	4.5-6.0	5.25
Ferrous ammonium sulphate (hard)	5.0-5.5	5.25
Ferrous chloride-manganese chloride	1.5-2.5	2.0
Iron-tungsten alloy		2.0
LEAD		
Fluoborate	1.0-1.5	1.25
Alkaline	Over 12.0	
Fluosilicate (infrequently used)	Very low	
NICKEL		
High pH; Watts solution	4.5-5.6	5.0
Low pH; Watts solution	1.5-3.0	2.25
Black nickel bath	5.8-6.1	5.95
Black nickel (still or barrel plating)	6.0-6.6	6.3
Black nickel bath	6.6-6.8	6.7
Black nickel plating on aluminum	6.1-6.8	6.45
Electroforming; soft bath, low pH	2.0-2.5	2.25
Electroforming; medium hard bath	2.0-3.0	2.5
Electroforming; double salt, hard bath	5.2-5.9	5.5
Low pH, high speed		1.5
Hard nickel bath	5.6-6.9	5.75
Bright nickel bath	4.8-5.2	5.0
Bright nickel bath (Brytex)	4.8-5.2	5.0
Hard nickel bath, low pH		2.0
Acid bath, bright plate		5.75
Ductile nickel plating bath, bright plate	3.6-4.0	3.8
Chloride bath, medium hard		2.0
Special all chloride bath	1.0-5.0	3.0
Sulphate-chloride, soft bath		2.0
Nickel-cobalt alloys	2.0-3.8	2.9
Nickel-tungsten alloys (ammonium citrate)	6.5-8.0	7.25
Still plating, general	5.4-6.0	5.7
Barrel plating, general	5.4-6.0	5.7
Gray nickel baths	5.6-5.9	5.75
High nickel content baths	5.2-5.4	5.3
Semi-hard nickel baths	approx. 2.0	
Low pH bath	1.0-2.5	1.75
Electrotyping on wax molds	6.4-6.8	6.6
Electrotyping on lead molds	6.0-6.4	6.2
PALLADIUM		
Diamino-nitrate bath	approx. 7.0	
Sodium palladium nitrite bath	4.0-5.0	4.5
Acid chloride bath	0.0-0.5	0.25
Ammino nitrite		7.0
PLATINUM		
Chloroplatinate		7.0
Diammino nitrite	2.0-2.5	2.25
Diammino nitrite		7.0
RHODIUM	0.0-1.0	0.5
RUTHENIUM	0.0-1.0	0.5
SILVER		
Cyanide	11.5-12.0	11.75
Cyanide (insoluble anodes)	13.2-14.0	13.6
TELLURIUM	0.0-1.0	0.5
TIN		
Acid	0.0-1.0	0.5
Stannate (Alkaline)	Over 12.0	
Continuous plating of sheet metal		2.7
ZINC		
Acid, Still plating	3.5-4.6	4.05
Acid, Barrel plating	5.0-5.3	5.15
Cyanide	13.2-13.7	13.45
Fluoborate bath, high speed	3.5-4.0	3.75
Fluoborate bath	4.5-5.0	4.75
Chloride-acetate bath		4.0

series opposition to a variable potential supplied by a slide-wire potentiometer. The net potential difference is amplified to operate an ammeter. The potentiometer dial is adjusted until the meter reads zero. At this point, the potentiometer and the electrode potentials are exactly equal, and the pH is read directly from the calibrated potentiometer dial. Figure V shows a commercial null-potentiometer instrument.

Either of these meters is recommended for determinations of pH on materials that are too highly colored, too turbid, or too viscous for colorimetric analysis. Outstanding for their precision, versatility, and rugged construction, they have found wide acceptance for the dependable measurement of pH.



(Courtesy Leeds & Northrup Co.)

Figure V—Null-Potentiometer type of pH meter.

Role of pH in Electroplating

In most cases of electroplating, the greatest effect of hydrogen-ion concentration is its influence upon the structure of the metallic layer formed during electrodeposition. Zinc, for instance, if in the presence of excessive acidity, is deposited as a spongy, porous coating. Pitted, cracked, and curled deposits result when iron or nickel are electroplated in the presence of abnormal acidity. In the latter instances, the brittle structures may be traced to the solubility of hydrogen in the iron and nickel. On the other hand, the proper regulation of the hydrogen-ion concentration of zinc, nickel, and iron plating baths favors the production of more uniform and durable electroplated surfaces. Obviously, every effort should be made to assure the existence of the proper pH during electroplating if high production standards are to be established and maintained.

The acidity of an electroplating bath plays a major role in determining the most economical consumption of materials as well as the formation of coatings of desired thickness, type, and finish. The improper pH of a plating bath may lead directly to uneven deposits or coatings of above or below optimum hardness. Unless the pH of an electroplating bath is carefully maintained, the metallic hydroxides will precipitate rather than the desired metal. Aimed at avoiding these hazards, pH determinations are among the most important operations carried out in modern electroplating shops.

Either colorimetric or electrometric techniques may be used in determinations of pH. In the case of cer-

(Concluded on page 75)

Ancient Origins of Plating

By Eugene W. Nelson, *Detroit, Mich.*

THAT the more basic metallurgical processes, such as smelting ores, casting molten metals into molds, hot and cold forging, etc., were understood in ancient days has long been acknowledged. It is only recently, however, that the archaeologists, working with metallurgists, have uncovered conclusive proof that a number of the more specialized metallurgical processes such as plating one metal with another, wire drawing through dies, etc., were also practiced many centuries ago.

A sport roadster with its radiator grille gleaming with chromium plate and its various gadgets and emblems protected from the ravages of weather by nickel, chrome, and even gold plate may seem to be the very height of applied metallurgy. Yet four thousand years ago Egyptian metal smiths were plating the base metals with gold and silver for the very same purpose—protection and beautification.

True, the Egyptian craftsman had absolutely no knowledge of electroplating as it is practiced in modern shops, but they did use several other methods which gave satisfactory results. The most obvious method, of course, was to wrap the object, say the handle of a mirror or the hilt of a dagger, in gold or silver foil. Numerous objects have been uncovered showing that the ancient metal workers did just that. Later came the idea of heating the foil-wrapped object and then pounding it so that the foil wrapping would adhere better to the base metal. And still later in history, objects were dipped into baths of molten gold or silver and plated in this way.

Incidentally, making gold and silver foil, or rather "leaf," was a well developed art among Egyptian metal workers as early as 2500 B.C. as is shown by various tomb drawings. From these paintings and the accompanying hieroglyphs, it has been possible to work out

Figure 1. Representation of an Indian goldsmith and his assistant, reproduced from an ancient Aztec "codex," or book of picture writing. Here, the master smith is shown watching intently while his assistant blows up the fire through a copper tube (bellows were unknown to the Pre-Columbian Indians) to make the fire hotter. The assistant also stirs the melting gold with a rod of some sort.

Figure 2. Another representation of an Aztec gold smith, also reproduced from an ancient book of Aztec Indian picture writing.

the procedure by which Egyptian goldbeaters prepared their leaf.

A "form," composed of alternate pieces of gold and bull's hide, was placed on a stone anvil. The smith held it with his left hand and with his right hand struck rhythmical blows with a heavy, handleless maul. Aside from the fact that goldbeaters today use a comparatively light wooden hammer instead of a shaftless stone sledge, there is little difference between modern gold-leaf-making practice and the ancient Egyptian method.

Egyptian gold leaf of the variety used for "plating" was often as thin as one-five-thousandth of an inch. This means that a pound of gold was made to cover a six-foot square. This was fully as good as any gold leaf manufactured until about the Eighteenth Century A.D. in Europe. Today, of course, a fine grade of leaf measures some 1/50,000 inch thick.

The human mind being what it is, we would naturally expect to find unscrupulous people turning to this plating process as a means of unlawful gain. This is exactly what happened, and in more than one country, too. A number of Greek and Roman coins, dating all the way back to 400 B.C., were metallurgically examined some time ago. It was found that all of these coins were nothing but disks of copper covered with thin coatings of either gold or silver. Further examination showed that a number of different methods had been employed to coat these spurious coins. Some of

the ancient slugs had been foil-wrapped and heated until a union had been formed between the dissimilar metals. Others had been silver-soldered with some kind of a flux. Still others had been prepared by sprinkling gold or silver powder over the discs and then heating them until the powder melted.

The Greeks and Romans, however, were not the only ones who took an unfair advantage of a knowledge of plating. In England, the practice of selling plated objects as if they had been made of the pure metal became so pronounced that during the reign of King Henry IV, the monarch passed a law prohibiting the plating of any base metal with gold or silver. This law went on to state solemnly that it would be perfectly legal to plate either gold or silver with any of the base metals—a rather grim joke on the part of old King Henry IV.

One of the most unusual cases on record of plating for unlawful profit is found in Spanish history. When the early Conquistadores brought platinum back from the New World, the Spanish metallurgists were unable either to melt or dissolve the metal. Just how the American Indians had been able to obtain pure platinum in the first place is not entirely understood—but the fact remains that they had pure platinum and made non-corroding fish hooks out of an alloy of platinum, gold, and silver. The Spaniards, in order to use this new metal, hammered slugs of it into discs, plated them with gold or silver, and so made counterfeit coins! Eventually the Spanish government had to pass a law banning the importation of the dangerous and "worthless" platinum.

The inhabitants of the Old World were not the only ones conversant with the uses of plating. In Pre-Columbian America, the Indians living in the Great Lakes and the Ohio River Valley areas made figurines and other objects of wood, then carefully covered them with thin sheets of copper to preserve the wood from decay, etc. Great skill was shown in this covering (or "plating") operation, and it would be somewhat difficult to duplicate their results even with modern tools. In some of the Ohio Indian mounds, copper beads

Figure 3. Reproduction of a *picture* on an ancient fresco at the Egyptian metropolis of Thebes. Dates from the 18th Dynasty. Picture shows an Egyptian metal smith using blowpipe and pincers, apparently for melting down gold. Above him is a representation of the goldbeater's "form," on top of which is the handless stone maul used by the goldbeater.

Figure 4. Reproduction of a picture drawn on the wall of an ancient Egyptian grave at Saqqarah. Dates from about 2500 B.C. Shows a series of Egyptian craftsmen. At extreme left is the goldbeater beating a goldleaf "form" with his heavy hand stone.

plated with silver foil have been uncovered; and certain Spanish priests reported that one exceptionally war-like Mexican tribe even made body armor of wooden plates covered with sheets of copper.

The ancient Peruvian Indians—commonly called the "Incas"—seem to have been the champion platers of the Pre-Columbian American world. At least *Pedro Sancho*, secretary to Pizarro, in his "Account of the Conquest of Peru," states that the Spanish soldiers collected "gold" objects to a total weight (in present day terms) of 156,250 pounds. This loot, on being melted down to pure gold, yielded only some 82,500 pounds of the yellow metal, Sancho proceeds to wail in his "Account." Quite evidently, much of the loot "accumulated" by the gentle Conquistadors had been plated.

A series of investigations conducted at the Museum of the American Indian by *Dr. W. C. Orchard* had yielded knowledge of how the Inca metal smiths accomplished their plating. Mercury, extracted from cinnabar which was well known to the South American Indians, was mixed with gold dust to form an amalgam. The amalgam was smeared over copper or bronze articles, the surfaces of which had been cleaned beforehand with an acid fruit juice. This apparently removed all grease and perhaps roughened up the surface of the bronze or copper, making the plating adhere more tightly. The prepared articles were then fired. The mercury vaporized, leaving behind it a thick plating of gold or silver. Dr. Orchard, in performing his experiments, followed hints found in the writings of various Spanish authors, so this is undoubtedly the method followed by the ancient American metallurgists.

Gold and silver, however, were not the only metals employed by the ancients for plating. Tin was also used, thereby foreshadowing the modern tin can industry. As far back as 23 A.D. *Pliny* wrote about the tin-coated iron vessels which the Romans preferred for cooking, since the pots so plated withstood the corrosive action of food acids better than did plain iron utensils.

Lead is a metal even now closely associated with pipe and plumbing work. Because lead is such an inactive metal, and also because it can be worked so easily, it was employed for these very purposes many centuries ago. The floors of the Hanging Gardens of Babylon, which were four-hundred feet square, were entirely lined with sheets of lead, the edges of which were securely fastened together by soldering. The soldering was good enough to provide watertight joints. If the lead sheeting had leaked, the floor would not

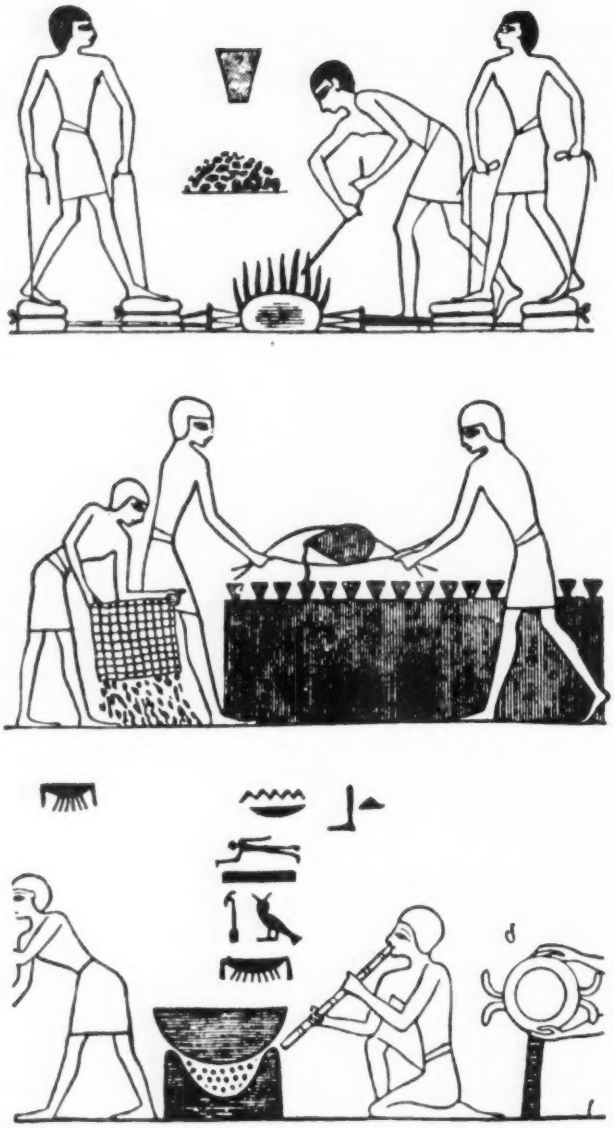


Figure 5. "Closeups" of sections of a larger picture representing work in an early Egyptian copper foundry. Original picture appears on the wall of a temple at Karnak, Egypt. Dates from about 1600 B.C. In (a) we see three Egyptian craftsmen using a bellows to blow up the fire used to melt copper. In (b), workmen are shown pouring molten copper into a mold, through funnel-shaped cups. Another slave dumps a sack of sand from which more molds are to be made. In (c), we see a metal smith blowing up a fire with a blowpipe. Apparently metal is being melted in the crucible suspended over the fire.

have been able to retain moisture for the luxuriant vegetation growing in the Gardens. Worse still, leaky joints would have let water seep down into the nobles' apartments which were located inside the structure of the Gardens. So the craftsmen really had an incentive to do good work, knowing that they would all be impaled and flayed alive if their soldered joints leaked.

Later on, the Romans used sheet lead in large amounts as a water-proofing material and for the lining of their famous public baths. Even the Roman baths in the far-away colony of Britain were so lined. The manufacture of lead pipe for sewage disposal was one of the most important industries in the Roman Empire. According to one Roman technical writer, *Vitruvius*, these pipes were formed by bending sheet lead around cylinders and then closing the seams by casting molten lead along them. The Roman manufacturers had even standardized the sizes of lead pipes.

In Pompeii, sheet lead was used to line the walls of bath rooms to prevent the absorption of moisture, and the lead was covered with stucco to provide a finished wall.

Use of lead as a roofing material has an ancient origin, too. In 123 A.D., for instance, when the Pantheon was erected in Rome, it was equipped with a lead roof. There is also some evidence to show that plates of lead had been used for roofing buildings in both China and in Egypt more than 4000 years ago.

There seems to be little connection between the weapons of the ruthless Viking sea raiders and modern suspension bridges, yet the steel wire used by the Scandinavian warriors to wrap sword hilts and axe handles and to sew steel plates to leather coats was manufactured by basically the same process that wire for steel suspension cables is produced today—that is, by drawing through a series of dies.

The knowledge of various quenching media for imparting different properties to steel was known to the ancients, although they seldom used anything as prosaic as plain water or clean oil.

For instance, here are the instructions for imparting a wonderful temper to a Damascus sword blade: "Let the high dignitary furnish an Ethiopian of fair frame and let him be bound down, shoulder upwards, on the block of the god Bal-Hal. Then let the master workman, having hammered the blade to a smooth and thin edge, thrust it into the fire of cedar-wood coals, in and out, while reciting the prayer of the god Bal-Hal, until the steel be of the color of the rising sun when it comes up over the desert towards the east, and then with a quick motion, let him pass the sword from point to hilt six times through the most fleshy portion of the slave's back, when it shall have become the color of the purple of the king. Then, if with one stroke the master workman severs the head of the slave from his body and the sword displays no nick or crack along the edge, and the blade may be bent around the body of a man and not break, it will be accepted as a perfect weapon."

Other quenching media were also popular in the long-dead past—such as "the blood of a red-haired boy" and water in which various foul and evil-smelling herbs had been steeped. Since it was popularly believed that "something" from the quenching liquid entered into the steel and strengthened the metal, there was absolutely no ceiling to the junk that was dumped into otherwise plain oil and water in an effort to improve on these media.

Modern methods of testing have proved that Damascus swords were inferior to swords made of modern heat treated alloy steel; that the brass and bronze of antiquity was not as pure as ours; that no ancient metal worker ever hardened copper except by alloying it or pounding the metal; and that present-day iron is purer and more corrosion-resistant than the best that the old timers could produce.

Nevertheless, we will always be in the debt of the ancient metal workers because they laid down such a strong foundation of metallurgical practices for us to build on.

The Bending Qualities of Hot Dip Zinc Coatings

By Wallace G. Imhoff, *Galvanizing Consultant, Los Angeles, Cal.*

Introduction

THERE are occasions when very definite technical information is desired regarding the bending qualities of hot-dip zinc coatings. Since the answer to that question cannot be specific, it is hoped that the information submitted here with the actual tests under various conditions will at least be helpful in deciding what is the best thing to do under the conditions at hand. In presenting a very complicated problem clearly, the best starting point is to make a list of some of the important factors that have a very decided affect on the bending qualities of hot-dip zinc coatings.

Factors Involved

The list of some of the most important factors is given below:—

1. The kind of zinc used.
2. Metals and alloys in the bath—
   a. iron
   b. aluminum
   c. lead
   d. cadmium
   e. antimony
   f. tin
   g. copper
3. Galvanizing bath temperature.
4. Submersion time in the molten zinc.
5. Thickness of the zinc coating.
6. Thickness of the zinc-iron-alloy bond.
7. Water quenching.
8. Quality of steel base.
9. Gauge of steel base.
10. Galvanizing practice; pickling, drying, fluxing, etc.

Kind of Zinc Used

Wire coatings, which must stand the severest bending, have long used the very purest grades of zinc for hot-dip galvanizing. However, an interesting side-light comes from one very large wire galvanizer where the zinc in the wire pot is only used for one week, and then is transferred to the pipe or other galvanizing department. The writer asked the galvanizer why it could only be used for one week, and the galvanizer's explanation was simply that he did not know, except that after one week the molten zinc was no longer suitable for wire galvanizing. A number of years after this incident the real reason was finally discovered. It was due to the fact that all molten zinc slowly takes up iron from production passing through the bath, so the answer was that one week's production of wire contaminated the pure zinc with iron to such an extent that it could no longer withstand the severe bending tests required for wire. Iron in pure zinc very quickly tends to make it hard and brittle.

Turning from very pure zincs that are used for wire galvanizing, there is also a very interesting practical condition that exists in the most common grade of zinc for hot-dip galvanizing, Prime Western zinc. Forty years ago most all zincs were made from virgin ore, and many of these ores were high lead-bearing, the lead ore being Galena, the lead sulphide. During smelting, up to as high as 2.00% lead might come down with the zinc, so that in 1911 the *American Society for Testing Materials* drew up the specification for Prime Western Zinc for hot-dip galvanizing and set limits of 1.60% as the upper allowable limit for lead, and .08% as the upper limit for iron. This was done because at that time lead was selling at a lower price than zinc, and the specifications thus stopped the selling of more than this 1.60% of lead at zinc prices. At that time, and ever since, it has never been thought necessary to set a low limit on lead content in zincs for galvanizing because even today there seems to be a difference of opinion as to the exact role that lead plays in the galvanizing bath, and in the zinc coatings.

Figure 1—A good quality hot-dipped zinc coating, with a bright smooth finish, large even spangles, and having good bending qualities. Immersed for 1 minute at 850°F (29 gauge stock).

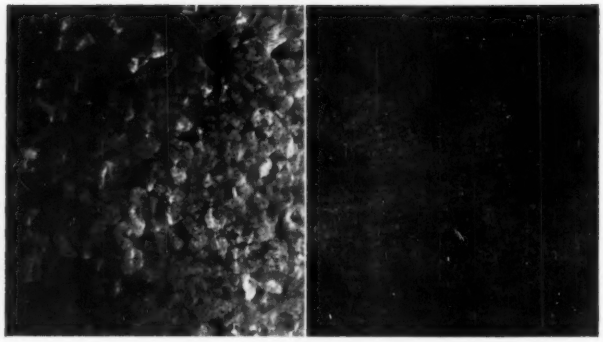


Figure II—Left illustration shows a coating produced at 815°F, right at 945°F. Small spangles in left hand photo are due to the low galvanizing temp., but otherwise the coating is of good quality. Coating on right has been "burned" at the high temp. used, and was hard and brittle. Immersion time for both parts was 1 minute.

The writer has for over twenty years recommended that at least 1.00% of lead should be carried in zincs for galvanizing. The past two wars has fully demonstrated that the metal lead is a vital and necessary metal in molten zincs. We have the paradox today that Prime Western zinc can carry up to 1.60% lead according to the A.S.T.M. Specification for slab zinc for hot dip galvanizing, or Prime Western zinc can be a slab zinc that carries little or no lead. The war fully proved that this condition should be studied, and some ruling also made on the lower limits of lead in zincs for hot dip galvanizing, as well as the upper limit of 1.60%. The writer has been using for many years an upper limit of 1.60% lead, and a lower limit of 1.00%, or the sum of lead and cadmium content equal to 1.00%.

During and after World War I, hot-dip galvanizing has been done on such an extensive scale that the by-products from such operations have run into thousands of tons of dross, oxide skimmings, and sal-ammoniac or flux skimmings. None of these by-products contain lead or cadmium in any appreciable amount. So very slowly and gradually a new secondary slab zinc made from these by-products came on the market, and since it met the specifications for Prime Western slab zinc for galvanizing, it took its place alongside of Prime Western zinc for hot-dip galvanizing. Thus it became possible to purchase Prime Western zinc carrying up to 1.00% lead, or the Prime Western zinc might not contain any lead. Most galvanizers did not know the difference until trouble developed: very high dross production; heavy, hard, brittle coatings; some would not stand much bending, while others peeled and flaked off; the bath was very hard to work with, etc. Costs soared because of excessive zinc per ton of product, and extremely high dross production often resulted.

Break Test for Lead Content

Since bending properties depend upon the malleability and toughness of a zinc coating, barring the other influences from discussion for the moment, it is very valuable to have a practical method of determining the toughness of the zinc without resorting to a chemical analysis. A quick way of discovering its toughness is by a break test. In most plants the railroad siding is beside the plant so that by simply throwing the slabs of metal across the railroad track a good idea can be obtained as to their toughness and malleability. Zincs that are very pure and that carry no lead are fairly brittle, and most of them will break after three to five throws on the track; an average lead-bearing zinc will usually stand at least seven throws across the track, and when it breaks it will show the slab has bent first, before breaking. The writer once found a very high lead-bearing slab zinc that withstood seventeen hard throws across the track before it finally broke, and when it did break it had a very big bend in the slab. Cases of very pure, non-lead-bearing zincs have been found where the slabs have broken on the second or third throw across the track, with absolutely no bending at all, and a rough, brittle fracture of the slab. Even though this lack of bending ability can be seen in the slab from the above practical test, it is in the galvanizing bath where the real lack of bending qualities are quickly magnified when the metal gets under heat.

A brief explanation will be of value in clearing up why zincs without any lead in them, or carrying very little lead, become brittle, and show low bending qualities.

The standard practice when starting up a new galvanizing pot is to put about two to four inches of lead in the bottom of the pot. In years past the reason given for this was so that drossing operations would be made easier by raising the dross off the bottom of the pot, and thus preventing the dross from sticking to the pot bottom. What happens in the pot is this; the zinc bath above the lead holds about 1.00% to 1.50% of lead in solution, depending upon the bath temperature. If the slab zinc used does not carry any lead, then the zinc bath above will slowly take up the molten lead it needs for maintaining an equilibrium, out of the bottom. This lead of course is slowly carried out of the pot as zinc coating, and new slab zinc without any lead is added. Finally all of the lead in the bottom of the pot has been used up, and then the trouble starts to build up. As the lead in the bath slowly diminishes and vanishes, the iron in the zinc has a magnified influence, and tends to thicken up the bath, increase the weight and thickness of the coating, gradually build up excess zinc used per ton of product, and reduce the bending qualities of the zinc by making it hard and brittle. If aluminum is used as a coating brightener, this adds to the trouble by aggravating a condition already giving much operating trouble.

There can be no argument about being right if by adding lead to the pot the trouble disappears, but that is only temporary if the purchase of slab zinc without any lead continues. The full remedy can only be effected when lead is put in the pot, and then zinc with at least 1.00 per cent lead, or a total of 1.00 per cent lead and cadmium is purchased. If the zinc without lead is continued, pure pig lead should be added at regular intervals to replace the lead carried out by the bath used for coating purposes. No lead, high iron, and high aluminum content of a bath decrease the bending properties very considerably.

Metals and Alloys in the Bath

That is an extensive and complicated subject to discuss in any detail. The purpose of this article is to merely call attention to the way the bending qualities of a zinc coating are affected by these various metals, even in what may be considered very small quantities.

a. IRON: Iron tends to make zinc brittle, and therefore as the iron in a galvanizing bath increases its bending qualities decrease. The iron content is vitally affected by bath temperature; the higher the temperature, the more dross, and the more iron. It should always be as low as possible.

b. ALUMINUM: Aluminum in itself under favorable conditions does not affect the bending properties to a serious extent for ordinary service, but when the service is severe, aluminum should not be used. Aluminum is not used in either sheet galvanizing baths or in wire galvanizing baths. It tends to thicken the molten zinc, increase the weight and thickness of the metal deposited, and thus indirectly reduce the bending properties. All galvanizing that is to be crimped and bent severely should never have aluminum in the bath. Tin and cadmium are both used in sheet galvanizing baths, but no aluminum.

c. LEAD: The role of lead has already been discussed in detail, and the opinion given that lead is very beneficial, and improves bending qualities by thinning out the zinc, and making it more fluid. This means a thinner zinc coating. At this point it is well to call attention to the fact that the metal lead up to 1.00 per cent in a galvanizing bath is not harmful in any way to the operators, and does not give off any poisonous fumes at galvanizing bath temperatures. Any statements to the contrary are in error of the facts.

d. CADMIUM: The metal cadmium in small amounts is very beneficial to zinc coatings in that, like tin, it tends to thin out the bath, give a lighter, thinner coating, and better bending qualities. This applies to amounts not over one-quarter of one per cent.

e. ANTIMONY: The metal antimony is a very hard. brittle metal and while small amounts are used for spangle lustre in the field of metal-ware galvanizing where no bending takes place, it should not be used in a bath coating strip steel, wire. etc., or any work where bending of the coating is a consideration.

f. TIN: The metal tin in small amounts thins down a galvanizing bath and therefore tends to give a thinner, lighter zinc coating which will stand bending and crimping.

g. COPPER: The metal copper is seldom put into a bath deliberately, but very small amounts of copper up to one-quarter of one per cent stay in solid solutions in the zinc and do not affect the bending qualities of the coating.

Bath Temperature:

There is nothing that will destroy the bending qualities of metals quicker than overheating them. Most metals are at their best molten temperature when fifty to seventy-five degrees above their melting point. Zinc melts at 786°F.; the low galvanizing temperature is 825-830°F.; 875-880°F. should be the highest temperature of galvanizing. 830-880°F., a difference of the narrow range of 50°F., is therefore the temperature range for best galvanizing. Once a glavanizing bath has been badly overheated the zinc becomes hard and brittle, and the bending properties are low.

Submersion Time

One of the most important controlling factors of the quality of zinc coatings is submersion time in the bath. For every kind of base metal, for every gauge of steel base, and for various sizes and types of articles, there is a correct and best submersion time in the molten zinc bath. If for any reason the submersion time is too long, then the coating begins to take up iron, it becomes hard and brittle, and its bending qualities decrease in proportion to the length of time the article has been in the bath. Pieces lost in the galvanizing bath build up a thick, brittle zinc-iron alloy all over them and become scrap. For the best bending qualities the submersion time should be as short as possible, consistent with a perfect coating. A thin zinc-iron alloy bond tends to give better bending qualities than a thick zinc-iron alloy bond which is formed by a long submersion time in the molten zinc.

It is interesting to study a research test revealing how the bending qualities of the zinc coating are affected by bath temperature and submersion time in the bath.

TABLE I

Bending Qualities for Different Temperatures and Submersion Times in the Galvanizing Bath:

Temp.	TIME - MINUTES											
°F.	10	20	30	40	50	60	70	80	90	100	110	120
800	1	..	..	..	..	..	..	..	..	..	..	..
820	1	1	1	1	1	1	2	2	2	2	2	2
840	1	1	1	1	1	2	2	2	2	2	2	2
860	1	1	2	3	1	1	3	2	3	2	3	3
880	1	2	2	2	3	2	3	2	2	2	2	3

The above rating for bend tests are as follows:

1. Means no cracks appear in the coating after 90

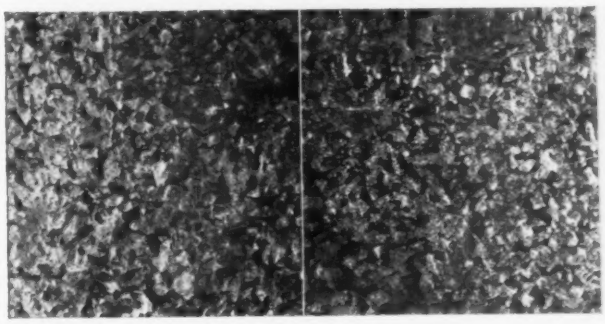


Figure III—Small spangles formed on left hand part are due to short immersion at high temp. (895°F—5 secs.); this can also be accomplished by a longer immersion at lower temp. (820°F—1 min.).

degrees bend to the left; small crack in coating after 90 degree bend to the right.

2. Cracks develop on 90 degree bend both to left and right.

3. Means large fractures and spalling of coating occur after bending 90 degrees to the left and then to the right.

The sheets galvanized at 840 degrees F. and ten seconds immersion time withstood the bend tests the best at all bath temperatures. The coating did not break until the steel broke.

The next best coatings were those deposited at from 10 seconds to 60 seconds immersion time. These coatings broke on one side after the first bend.

The poorest coatings were those coatings which were deposited with an immersion time of 1 to 2 minutes. These coatings fractured on both sides.

Thickness of the Zinc Coating

Thin zinc coatings always have much better bending qualities than thick zinc coating. There is a very definite reason for this as generally such a coating is contaminated with iron or some other metals that tend to reduce the bending qualities. Thick coatings are generally applied to heavy work like angles, girders, etc., that are used in outside construction work like switching stations, and high tension towers. Such articles are never bent, and the thick coating is put on as a better resisting medium to corrosion and exposure to the weather. Light, thin coatings are usually on light gauge steel, and this type of a coating will withstand bending and crimping, etc. A thin coating is usually a purer zinc coating, and also has a thin zinc-iron-alloy bond, which permits bending.

Thickness of Zinc-Iron-Alloy Bond

The zinc with lead in it in small amounts is ductile, but when iron enters into the coating either in the upper zinc layer, or in a heavy alloy bond, the bending qualities deteriorate. Since this zinc-iron-alloy bond is very hard and brittle, and cannot be bent without breaking, it can readily be seen that the thicker this alloy bond is, the lower will be the bending qualities of the coating. The thickness of the bond is affected by both bath temperature, and submersion time. The temperature increases the speed, or rate of formation of the bond, and the submersion in the bath, increases the thickness of the bond. There is an upper zinc-rich bond, and a low iron-rich bond. Above the zinc-rich bond is the zinc layer, and below the iron-rich bond is the base metal. Bending produces slipping between these various layers, and naturally the thicker the layers, the more the slipping and breaking up and mashing of the brittle material forming these alloy bonds.

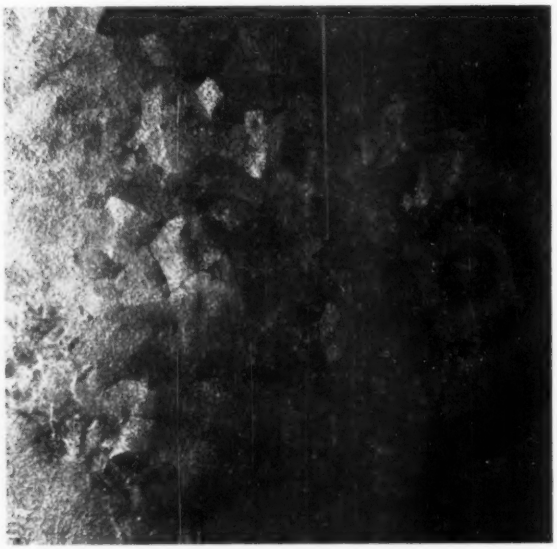


Figure IV—Coating produced at the very low temp. of 786°F., just 4° above the melting point of the zinc. The large spangle is due to a long immersion time of 2 mins. This coating has good bending qualities.

Water Quenching

Cooling a zinc coating, or setting the zinc, is not as easy and simple an operation as it appears to be when watching it done. As a typical example of what happens when this operation is done wrong, a new operator was on the quenching operation, and in order to maintain his required production he did not allow the castings to drain properly. With heavy zinc run-off still on the articles he dropped them into the water quench tank and left them there. They came out looking beautiful, but a few weeks later five carloads of parts were all returned because of peeling and flaking of the coating. The operator on the water quench tank did not understand the operation. He should have allowed the metal to drain fully, and then instead of dropping the articles into the tank and leaving them there for a long time, they should have been quickly lowered into the tank, and just remained there long enough to freeze and set the coating, and only cool the article enough so that the heat held in reserve would not burn the coating off, or burn it white, when removed. Thus proper freezing and draining the zinc is important as a factor in bending qualities, and the water quench operation should only be in the hands of an operator who really understands the requirements of properly setting the coating.

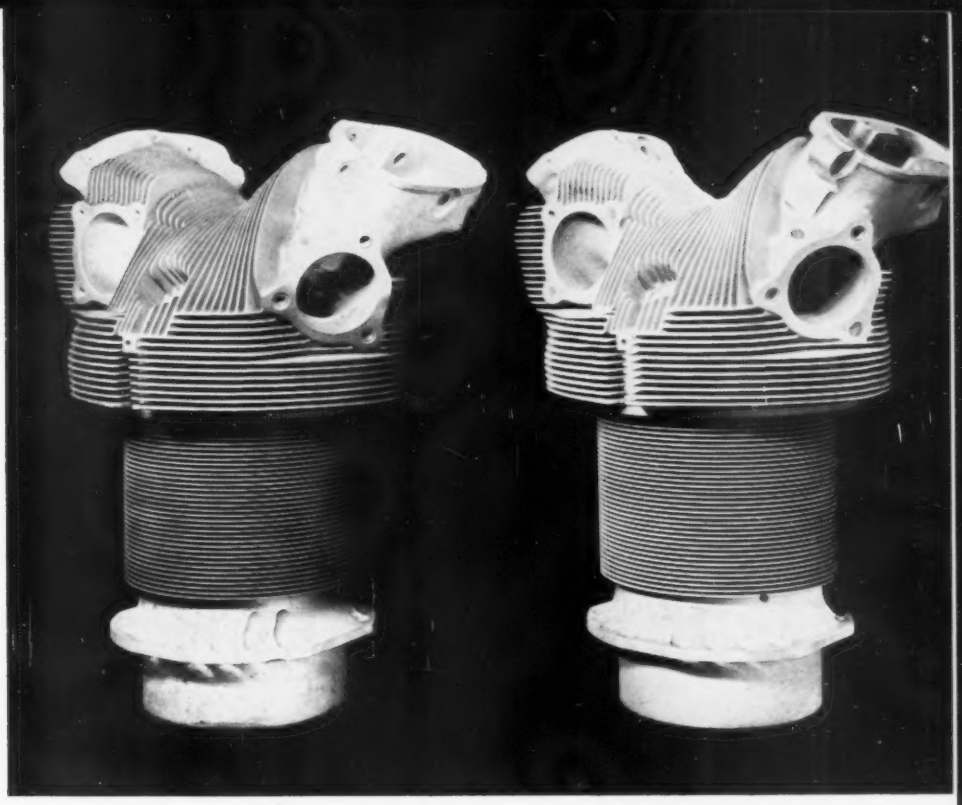
Quality of the Steel Base

Base metals that are high in phosphorous and silicon will not galvanize properly, and when the bath temperature, or submersion time must be changed to try to make the coating adhere properly, then the bending qualities are also radically affected.

Gauge of Steel

It is only natural that a heavy steel base is not bent except under special circumstances. Most bending and forming is done on light gauge base metal. Even fairly heavy corrugated culverts give by far the best service when the base metal is first corrugated, and then galvanized after corrugating. Sheets for a high degree of forming and bending are generally not only very light gauge sheets, but in some cases where extreme bending and crimping are required, the sheets are run down into a molten lead bath, and up and

(*Concluded on page 75*)



Pickling vs. Grit Blasting for Cleaning

By J. F. Farrell, *Industrial Engineer*

Introduction

THE use of acid pickling for removing scale and oxides from metal surfaces is one of our oldest metal cleaning processes, and it still finds application in the preparation of surfaces for practically every type of metal finishing operation. The process, however, requires careful control to avoid the dangers of pitting, hydrogen embrittlement, smut formation, etc., and it raises a host of problems pertaining to health and safety that have received widespread attention and consideration.

Over the years there has been a continuing search for more efficient and more healthful methods of removing these oxide films. Many methods have been tried, but each developed disadvantages of its own just as serious as those of pickling and, as a consequence, pickling has held its place. During these same years, there have been many refinements and improvements in the pickling process itself. The use of inhibitors has lessened the danger of pitting and hydrogen embrittlement, and careful hooding and ventilating arrangements have removed much of the health hazard.

In the meantime another process has grown considerably in stature and has begun to overlap the field of applications once covered by pickling. This process, abrasive blast cleaning (or grit blasting) is far from new and, by the same token, present blast cleaning equipment is a far cry from the early sand blast outfits where the operator worked in a cloud of fine silica dust. Early sandblast equipment had the added disadvantage of being relatively expensive to operate because of the high cost of compressed air and the serious wear on the equipment resulting from the abrasive nature of the blast.

A long, slow series of developments have worked to lessen these faults until today the process is being used in plants of all size and description throughout the country. The development of metallic abrasives eliminated the danger of silicosis in those cases where only scale and oxide were to be removed, and at the same time reduced the wear on the equipment itself, thus reducing the cost of the operation. More wear resistant materials were developed, further reducing the cost of the operation. New work handling methods with the operator working on the outside of a properly ventilated and carefully sealed cabinet brought about the final improvement in safety, and the development of centrifugal blasting made possible great increases in productivity with equally great decreases in the cost of the operation by eliminating the need for expensive compressed air.

With the development of centrifugal, or airless blasting, it has become practical to greatly reduce the use of acid pickling in removing scale from rolled and forged metal products and as a surface preparatory treatment prior to galvanizing, plating, etc. In view of the increased attention being accorded the problem of

All photos courtesy of American Wheelabrator & Equip. Co.

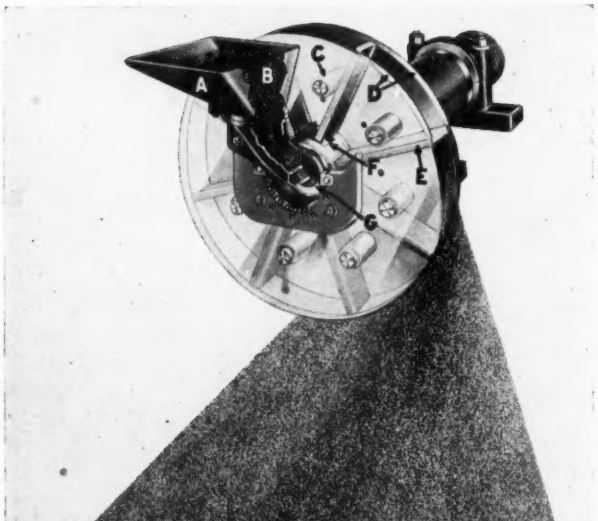


Fig. 1. Phantom view of an airless blasting-abrasive thrower, showing (A) Abrasive funnel, (B) Abrasive (metallic shot or grit), (C) Spacers between side plates, (D) Special steel side plates, (E) Cast alloy blades (removable), (F) Cast alloy control cage (stationary in operation). Change in direction of abrasive flow can be obtained by turning the control cage, which changes the position of the opening, and (G) Cast alloy impeller. (Rotates with the wheel). This unit carries the abrasive to the opening in the control cage where it is discharged to the bladed section of the wheel.

stream pollution and waste liquor disposal, the possibilities offered by blast cleaning become especially timely and warrant further consideration.

When compared to pickling, blast cleaning offers several advantages but, naturally, it has certain disadvantages and limitations of its own. Some of these advantages and limitations will be discussed briefly here with the thought of focusing attention on the basic factors affecting the use of blast cleaning as a substitute for pickling, and, in this way, aid any individual plant operator in deciding the relative merits for his own specific case.

Types of Equipment for Blast Cleaning

For a better understanding of the factors involved in the use of blast cleaning, it may be well to first review the equipment used.

In general, blast cleaning equipment may be classified into two categories according to the method used in propelling the abrasive. These are either "air blast" or "airless blast."

In airblast equipment, compressed air is used to force the abrasive through a small orifice or nozzle. The resulting abrasive stream is confined to the shape of a small, narrow cone and the entire effect of the blast is directed against one small area. This is the older of the two methods and is slower and more costly of operation, but it has these two advantages: when an adequate supply of compressed air is already available, it represents an appreciably lower initial investment and it is particularly suited for cleaning the interior of deep or narrow holes and recesses.

Airless blast equipment, on the other hand, uses centrifugal force instead of compressed air to propel the abrasive and thereby eliminates the need for costly compressed air. The abrasive is fed into the center of a bladed wheel similar to that shown in Figue 1. It is picked up by the rapidly rotating blades and accelerated as it moves toward the periphery of the wheel. Its final velocity as it leaves the wheel may be well in excess of 12,000 feet per minute. Positive directional control is provided by a control cage and impeller mounted in the center of the wheel and the resultant blast pattern has a fan shape as shown in the illustration.

A standard wheel unit, 19½" in diameter and 2½" wide, is capable of throwing 300 to 500 lbs. of abrasive per minute with a power requirement of 15 to 20 horsepower. If the same amount of abrasive were to be forced through five ⅜" nozzles at a comparable velocity by airblast, a 190 HP compressor would be required to provide the compressed air. Another relative advantage that airless blasting possesses lies in the difficulty encountered in trying to keep compressed air completely dry. This factor becomes especially important when the part is to receive some further finishing treatment.

Various auxiliary equipment is also needed with either type of equipment. It is necessary to have some sort of elevator or return feed to carry the re-usable abrasive to the storage hopper. An abrasive separator is necessary to remove the broken abrasive, dirt and scale from the material being returned to the storage hopper. And last, the dust created by the blasting operation requires a ventilation and dust collection system.

Another factor of very considerable importance is the choice of abrasive to be used. This will be controlled, to a large extent, by the specific finishing operation being considered and it will be discussed in detail at a later point in this paper.

Advantages of Blast Cleaning

By eliminating the use of acid and relying entirely upon mechanical action to remove scale and other surface impurities, blast cleaning successfully avoids many of the defects possible with pickling. No pitting, blistering, embrittlement, etc., occurs and the resulting surface has a uniform matte finish that provides a good base for subsequent polishing, plating, or painting operations and an even surface for cold rolling or further machining.

Scale is removed directly and there is no appreciable loss of virgin metal unless the work is kept under the blast for an excessively long period of time.

There is no problem of waste liquor disposal. Scale and spent abrasive are trapped in abrasive separators and dust collectors and can easily be disposed of. Where proper equipment is available it is possible to reclaim spent abrasive by sintering and charging to the melting furnaces, or by other similar methods.

There is no problem of burns or fume inhalation to make the work hazardous although dust collector equipment is still necessary, as has been pointed out.

Variations in alloys to be cleaned require no changes in the equipment or materials, and may be accom-

modated by simply varying the cleaning time or blast velocity. The cleaning process may be as continous and rapid as production facilities require. In acid pickling, a separate bath usually is required for each type of base metal.

Disadvantages and Limitations of Blast Cleaning

One of the first and most obvious disadvantages normally associated with blast cleaning equipment of any type is the fact that the equipment is, by its very nature, self-destructive. The switch from sand to metallic abrasives changed the emphasis from abrasion cleaning to impact cleaning and, in so doing, greatly reduced the wear on the equipment. All modern blast cleaning equipment is carefully designed with an eye to concentrating as high a percentage of the abrasive blast as possible on the work surface to be cleaned. Baffles and shields are placed in strategic positions to protect working parts of the equipment from rebounding and ricochetting abrasive, but in spite of all these efforts it still is not practical to operate the equipment in absolutely continuous operation for periods of much over one week.

How long and how well blast equipment operates depends to a very large extent on the type of maintenance it receives. There are installations, notably in steel mills, which operate continuously for 160 hours with only one 8 hour maintenance period per week, and this same type of operation is possible on most applications involving only the removal of scale and oxide from the surface, *if* proper maintenance and operating rules are followed.

The recent development of steel shot offers the possibility of considerable increases in wear life—possibly as much as five times that achieved with chilled iron abrasives. It is expected that this will be commercially available in large quantities in a relatively short period of time.

A minor disadvantage lies in the fact that blast cleaning is a dust creating operation and requires proper ventilation and dust collection equipment. Modern design is such that, so long as proper ventilation is supplied, the dust and flying abrasive present no problem. Reasonable maintenance efforts will eliminate any possible danger or discomfort from flying abrasive and leaks in the ventilating system.

Table I presents a few examples of cases where blast cleaning has successfully fitted into an operation formerly handled by pickling. One queston that will probably arise after a consideration of this table is, "Why is it that pickling can be completely eliminated in some cases while in others an acid rinse is still required?"

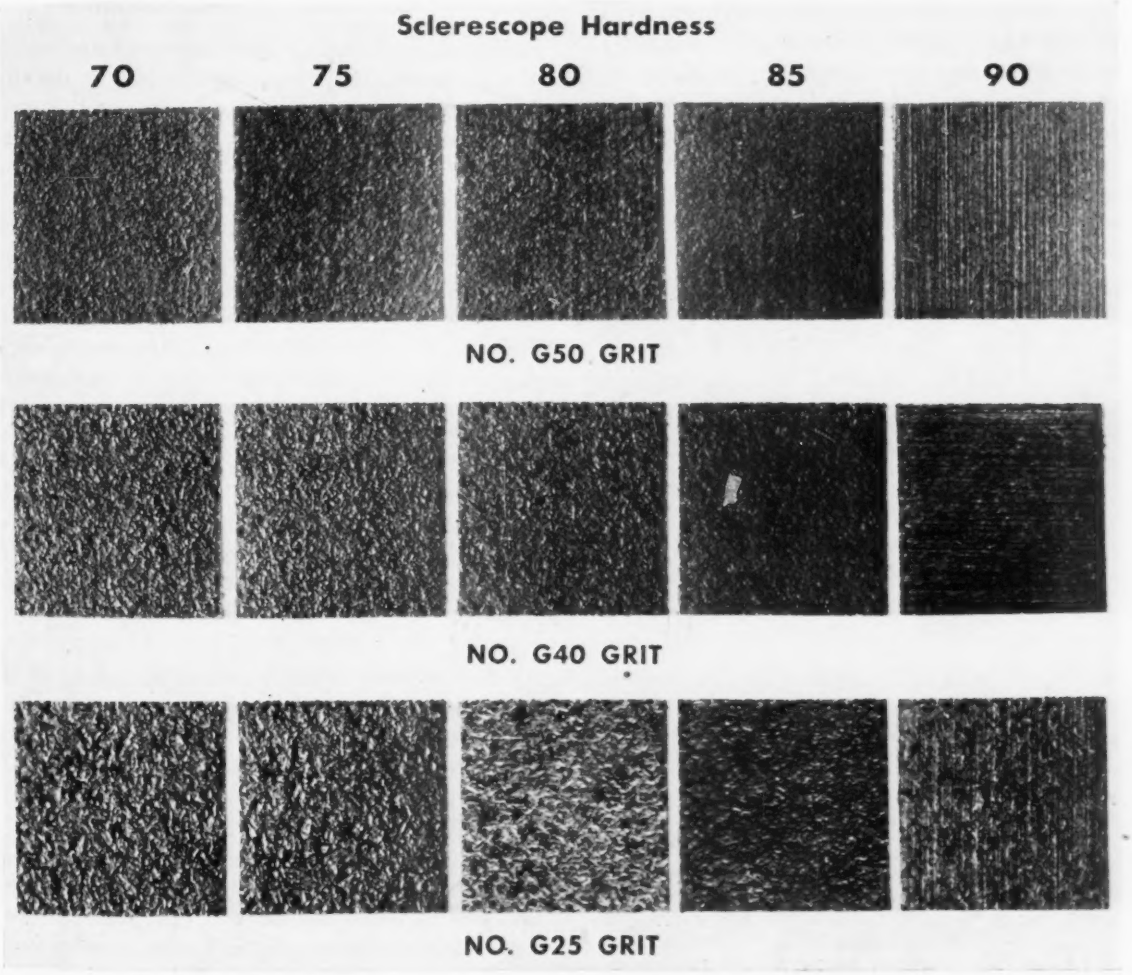


Fig. 2. Examples of typical finishes, magnified five times, produced by grit blasting. These samples were produced on steel surfaces of the indicated hardness by airless blasting at a uniform rate of approximately nine (9) square feet per minute. Grit numbers refer to S.A.E. classifications.

In some cases there is no apparent reason other than the personal preference of the executive in charge. In most cases, however, it is a result of the operating procedures in effect at the plant in question. Where the production set-up is arranged in such a way that the work can be conveyed directly from the blast cleaning operation to the polishing and plating operations, it is usually possible to proceed directly after cleaning with no intermediate acid rinse. If the work is stored for any appreciable period of time, or is handled with bare hands, it is good practice to give the part a brief acid dip to remove any rust, before plating operations are begun.

In other cases it is a result of economic and space considerations. For example, consider the case of a plant set up for the continuous pickling of steel strip or sheet prior to cold rolling or plating. If it becomes necessary to increase the capacity of the line and space does not permit the addition of another pickle tank, it may be desirable to remove one tank and replace it with a blast cleaning machine designed to remove sufficient scale to allow the remaining pickle tanks to remove the residual scale at a rate sufficiently fast to comply with the new production requirements. In this case blast cleaning equipment would have eliminated only 50% or 75% of the pickling requirements for the production rate achieved.

One additional reason for the acid rinse after blast cleaning is the desire to remove the iron dust from the surface of the part. Where the work goes directly from the blast cleaning operation to the finishing department this is apparently not so important, since the act of immersing the work in the various cleaning baths washes off or dissolves any troublesome metallic dust that may be on the surface. However, this problem assumes greater importance where the material is to be cold rolled after blast cleaning and before plating. In this case the iron dust on the surface may damage the rolls and cause surface defects in all of the work.

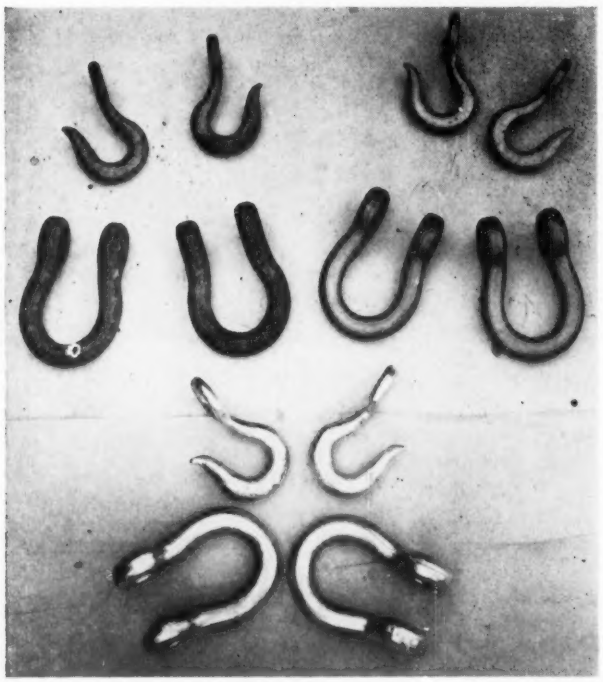


Fig. 3. Three stages in the manufacture of forged hooks. The upper samples are before and after grit blasting, while the lower ones are after galvanizing. These parts are galvanized immediately after blast cleaning with no intermediate acid rinse.

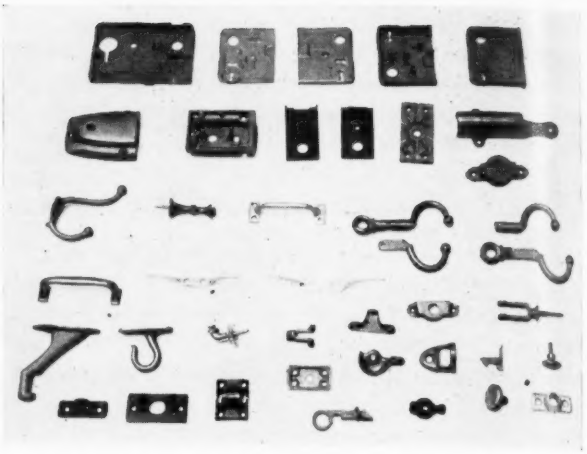


Fig. 4. Examples of various hardware parts which are being cleaned by abrasive blasting in preparation for different plating and painting processes.

In the case of stainless steel or some of the nonferrous metals, where no subsequent plating or passivating operation is anticipated, it is important that the iron dust be removed by some means in order to prevent discoloration of the surface.

Economics of Blast Cleaning

One of the most important questions concerning the two processes (the economics of which is the cheaper to install and operate) cannot be answered as yet. In those cases where a complete new cleaning room set-up is required and an acid disposal plant would be necessary if pickling were used, blast cleaning would unquestionably be the cheaper installation. However, in those cases where an acid disposal plant is not required (and this is becoming less likely as time goes by), and especially where some pickling equipment is already installed, the question becomes much more difficult to answer and must be decided for each individual case.

In general, however, when space considerations and building costs are taken into consideration, blast cleaning equipment is usually the cheaper to install. As an example of how great the savings may be in some cases, the case of a large steel company which faced the problem of increasing its cleaning capacity can be cited. After carefully studying the problem, the company's engineers found that the addition of a heavy-duty blast cleaning machine to a 300 feet per minute continuous pickle line would increase the speed of the line to 500 feet per minute and would cost approximately $250,000 including all charges for remodeling the line. It was estimated that to secure the same increase in production by installing a new continuous pickle line would cost approximately $1,500,000.

The question of operating costs simply cannot be answered in a generalization covering all applications. It is probably true that for every case where blast cleaning has shown lower operating costs, another case can be cited where pickling is less expensive than blasting.

One of the important factors affecting operating costs is the labor and time involved. Blast cleaning's

primary economic advantage lies in the greatly increased production it allows in a given floor space and length of time, and with no increases in labor. On the other hand, maintenance requirements are likely to be higher and must be balanced by actual savings resulting from the increased production. In plants where time and floor space are not critical factors in the cleaning room, pickling may prove to be less expensive. A careful analysis of the requirements for any specific application should indicate, with reasonable accuracy, which would be more economical.

Effect on the Finish

In considering the application of blast cleaning to specific surface finishes, we are faced with the question of where to start and stop among the many thousands of specialized finishes on the market today. For simplicity and clarity we will limit this discussion to the group that might be referred to as "metal coating" processes. This will include hot-dip galvanizing, electroplating, metallizing, and cladding.

All of the metal coating processes require that the surface of the base metal be thoroughly cleaned prior to the application of the finish coat. This usually includes the removal of all oil and grease as well as hard encrusted materials such as scale, rust, paint, dirt and others. It is in the removal of these dry, hard materials that blast cleaning finds its major application.

Although abrasive blasting has been used in connection with most of the metal coating processes, it has found its widest and most successful application in preparing surfaces prior to hot-dip galvanizing operations.

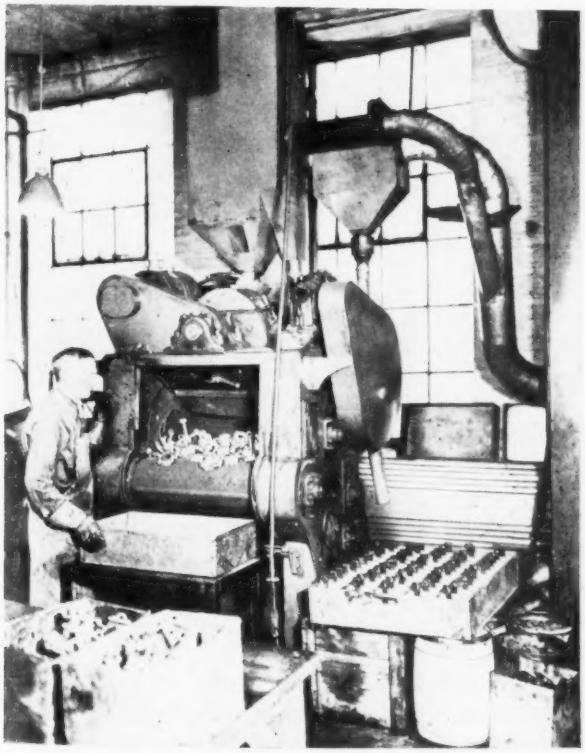


Fig. 5. A load of connecting rods about to be discharged from a 2 cubic foot blast cleaning machine. Depending on the operating procedure of the particular plant, these may be cleaned prior to babbitting to provide a better bond, or they may be cleaned afterwards to remove all flash and overflow.

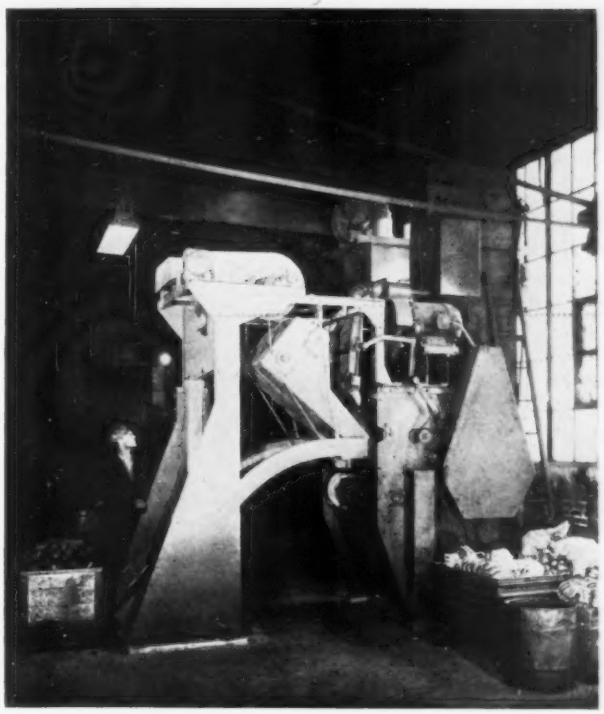


Fig. 6. Loading the blast cleaning machine with the mechanical loader reduces loading time and speeds up the operation.

In addition to the actual mechanical cleaning of the surface, abrasive blasting has another effect which may be an advantage or a disadvantage, depending on the application. This is the fine etch the process leaves on the surface of the part. The degree of roughness can be controlled to a large extent by the size abrasive used and also by the velocity of the blast.

The effect of surface roughness on the bond produced is still a subject of considerable discussion and it is difficult at the present time to make any generalized statements. The New Jersey Zinc Co. has done experimental work on galvanizing which indicated that where coatings capable of withstanding bending deformation are to be produced, the surface of the steel should be as smooth as possible. On the other hand, the Tin Research Institute points out in one of its publications that "the tinning quality of a 'difficult' surface may be somewhat improved by roughening."

In the case of cast iron surfaces, the Tin Research Institute calls attention to the fact that iron castings have a hard skin containing a high percentage of silica and graphite which must be removed. For each type of tinning process considered, they recommend a prior mechanical preparation either by machining, grinding or blast cleaning.

In the case of metallizing operations where melted metal is spraying onto the part to be coated, it is again essential that the surface be thoroughly cleaned. An extremely rough surface is usually required and rough machining is recommended on parts of suitable shape and construction. In those cases involving a large production or where intricately shaped parts are to be metallized, blast cleaning has been used with good results.

Electroplating represents a type of finish where abrasive size is of more than ordinary importance.

TABLE I

Material Cleaned	Type of Scale	Reduction in pickling	Subsequent Operations	Comments
Forgings	Forging scale	100%	Machining, galvanizing and plating	
Universal joints	" "	100%		5 minute blast cleaning eliminated 4 hour pickling.
Cable sockets	" "	100%	Galvanizing	Sockets requiring overnight pickling are blast cleaned in 15 minutes
Steel forgings	" "	60%		
Connecting rods and Gear Blanks	" "	100%		Blast cleaning production rate is 3 times that of pickling.
Hardware	" "		Galvanizing	All pickling eliminated except for brief acid rinse.
Hardware	" "	100%	Galvanizing	Parts galvanized immediately after blast cleaning.
Job Shop			Galvanizing	Brief acid rinse unless part rusts in storage.
High silicon electric steel strip	Hot roll scale	95%	Cold rolling	30 seconds acid rinse.
High carbon strip	" " "	100%	Cold rolling	Very fine abrasive used to eliminate acid rinse.
Tin plate strip	" " "	75%	Cold rolling	30 seconds acid rinse.
Sheets for Culvert Stock	" " "	95%	Galvanizing	Brief acid rinse.
Pipe Skelp	" " "	100%	Electric Welding	Cleaning edge only at cost of 96c. per ton.
Seamless alloy steel tubes	" " "	100%		Interiors cleaned by airblast.

Coatings deposited electrolytically are usually kept thin, and a bright, mirror-like surface is normally desired. For this reason, fine blast abrasives are used. Certain parts may then be plated directly, while others requiring the highest surface lustre will require polishing and buffing operations after blast cleaning. One additional point that may well be pointed out in connection with electroplating is that blast cleaning actually increases the surface area of the metal and thereby raises the minimum current density required for coverage.

Abrasives

For most cleaning and finishing operations, the abrasive used is a chilled iron grit or shot, although sand, silicon carbide, aluminum oxide and many others have been used. Metallic abrasives have several advantages, the most important of which lies in the fact that they cause much less wear on the cleaning equipment than do any of the other abrasives mentioned. This difference is illustrated by the fact that a standard, high grade nozzle is guaranteed for 1500 hours if used with metallic abrasive but for only 750 hours if used with sand or similar material. The difference in life is much more marked in the case of airless equipment where blade life may be many times greater with chilled iron grit than it is with sand.

It should not be assumed, however, that the cleaning ability of the different abrasives is proportional to the wear they cause in the equipment. When we consider cleaning ability, another factor enters the picture—the specific gravity of the particles. Chilled iron abrasive, because of its greater weight, has much more striking force than any of the non-metallic abrasives. It changes the emphasis from abrasive cleaning to impact cleaning and, as a result, its cleaning rate is equal to or greater than that of the non-metallic abrasives in most cases.

The primary disadvantage encountered in metallic abrasives is the possibility of contaminating the surface with iron dust. This is of special importance in the case of the non-ferrous metals such as aluminum, magnesium and zinc. Special treatments are frequently required to prevent discoloration and electrolytic corrosion when iron grit is used on these surfaces. It is in these cases that the non-metallic abrasives find their most frequent application.

The choice of abrasive size is largely a matter of individual preference, but it has considerable effect on the type of finish produced and the cleaning time required. If coarse abrasive is used, more coating material is required to fill in the surface to a smooth finish but the cleaning time is reduced considerably. A compromise between these two economic factors must be reached for each application.

Figure 2 illustrates the type of finishes produced by different sizes of abrasive on materials of varying Sclerescope hardness.

In discussing the application of blast cleaning to any

problem, it should be noted that the process is intended only as a means of removing hard, dry materials; and if oil, tar and other gummy materials are present they should be removed ahead of the blast cleaning operation. This is important because of the effect viscous materials have on the abrasive. When the abrasive becomes contaminated it tends to agglomerate and plugs up the elevators, feed lines and hoppers, necessitating costly shutdowns to clean out the equipment.

Typical Applications

The following actual applications will serve to illustrate the practice followed in some cases where blast cleaning is used prior to metal coating operations.

Loads of small forgings which are cleaned in a batch type blast cleaning machine are being galvanized directly after the cleaning operation with no intermediate acid rinse. See Figue 3. The cleaning time required in this particular case ranges from 6 to 12 minutes per load, depending on the type of part being cleaned. The machine used has a capacity of 11½ cu. ft. per load and the abrasive used is a mixture of S230 and S330 chilled iron shot.

Bearing inserts which require a very fine finish prior to silver plating are being cleaned with G50 grit with a cleaning time of 12 minutes per load.

Cylinders for aircooled radial aircraft engines were blast cleaned in a specially designed cabinet prior to metallizing. A No. 20 Alundum abrasive was used and a blasting cycle of 65 seconds per cylinder provided adequate cleaning. The abrasive blast thoroughly cleaned and roughened the deepest crevices between the cooling fins. The cylinders were metallized directly after the blast cleaning operation. See photo at beginning of this article.

The use of blast cleaning in the preparation of surfaces prior to cladding operations as well as in the manufacture of terne plate, offers a possible further application for this type of equipment. These operations are so similar to many other plating and bonding operations where blast cleaning is being successfully used that it seems likely that the process would be readily adaptable. Extensive tests would be necessary, however, before the actual advantages of such an application could be determined.

Summary

While blast cleaning has the definite advantage of improving working conditions in the cleaning room and eliminating some of pickling's more common defects, its application will be limited by the production and operating conditions in effect at any given plant and each case must be decided on its own merits.

In addition, it should be emphasized that the information presented here represents a summary of experience on many different installations and cannot be taken as the final word on any new application. In all cases it is best to first conduct actual tests which follow as closely as possible actual operating conditions to determine conclusively the type of equipment, abrasive and operating procedure best suited to the particular application.

HOT DIP ZINC COATINGS

(*Concluded from page* 61)

out through a molten zinc layer of shallow bath depth on top of the lead. This gives an extremely thin light coating that will take very severe bending and crimping without cracking, and without peeling and flaking of the coating.

PICKLING, DRYING, FLUXING, ETC.

As might be expected there are many operations in hot-dip galvanizing practice that may affect the bending qualities of the coating. "Burning," or overpickling may give such a heavy coating that it will stand little bending; drying may be too severe and too hot, producing corrosion that will affect the bending qualities. Even fluxing when done wrong can so affect the coating that it will greatly reduce the bending qualities.

Conclusions

To obtain highest degree of bending qualities:

1. Use Prime Western zincs with up to 1.00% lead, or lead plus cadmium equal to 1.00%.
2. Metals and alloys in the bath:
   a. Lowest possible iron.
   b. No aluminum.
   c. No antimony.
   d. Not over 1.00% tin.
   e. Not over 0.25% of copper.
3. Galvanizing bath temperature not over 860°F.; the lower the better; but not under 825°F.
4. Submersion time in the molten zinc as short a time as possible consistent with perfect coating.
5. Thinnest coating possible.
6. Thinnest zinc-iron-alloy possible.
7. If water quenched, proper technique; dipped in and out.
8. Highest quality steel base with minimum phosphorous, silicon, and sulphur.
9. Maximum bending with thin light steel base gauges.

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pH—ITS MEANING AND DETERMINATION

(*Concluded from page* 68)

tain plating baths, these two methods do not yield identical results primarily because of the high concentration of salts present in solution. In control operations, if the plater maintains the pH of his bath so that the desired color is produced on this test paper, the salt error is of no great significance. Nevertheless, for an exact numerical determination of pH, the plater must turn to electrometric techniques.

The accompanying Table I provides an overall picture of the pH requirements for most of the major plating solutions.

Quite obviously, the electroplater can have no greater ally than the chemical and electrochemical equipment available for the determination of pH, for only through the precise regulation of hydrogen-ion concentration can the electroplater insure ideal shop performance.

Shop Problems

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Heating Abrasive Grains for Polishing Wheels

Question: We have been told that the powdered grains that we use for heading up our wheels should be heated. What would be the purpose of this?

N. H.

Answer: Heating the abrasive grains will enable you to get a more uniform coating of abrasive on the glued wheels, as the grain would otherwise chill the glue and prevent the glue from bonding properly to the grains. By heating, more abrasive can be held by the glue, which means more hours of polishing time before the abrasive is worn away to the point where it must be renewed. A temperature of 120°F. is usually recommended for the abrasive.

Removing Phosphate Coatings

Question: We have some parts that were given a phosphate coating in preparation for painting, but we have since decided to put a plated coating on them instead. Can you tell us how to remove this phosphate coating without having to do too much polishing or buffing, and so the plating will stay on?

M. R. F.

Answer: Phosphate coatings are of several types and a different strip is used for each type. These solutions are as follows:

1) Conc. Ammonium Hydroxide—Room Temp.
2) 20% Chromic Acid—temp. 160°F.

I suggest you try several parts in each of these solutions to see which is best for your particular type of coating. The surface may be left slightly roughened after the phosphate coating is removed, but a light polishing operation should be all that is required to prepare the parts for plating.

Arsenic Plating

Question: What is arsenic plating used for and how is it done?

W. T. F.

Answer: About the only use we know of for arsenic deposits is for producing a dark colored finish that can be "relieved" to give antique effects. To the best of our knowledge, there are no commercial uses for arsenic plated articles.

Bright Finishing Pitted Stock

Question: In the manufacture of our parts, we have on hand a large quantity of hot-rolled steel sheet which after pickling seems to be pitted more than usual. This makes it necessary for us to do extra polishing to produce a satisfactory bright chrome finish. As steel is hard to get, we cannot afford to throw away the stock, and we wonder if you can suggest anything that will help us to process this material economically?

F. T.

Answer: In pickling this type of stock, every precaution should be taken to insure that overpickling is not causing pitting, and for this purpose a good inhibited acid should be used. You might also investigate sandblasting as a means of removing the scale without the danger of overpickling. The bulk of your polishing work should then be performed with coarse abrasives, starting with a No. 50 or No. 60 abrasive wheel or belt. This can then be followed by No. 90 and No. 120 grain operations. The parts can then be plated with a heavy deposit of soft copper from one of the high speed copper baths, and this copper deposit "flowed" over the surface by buffing to produce a surface smooth enough for the subsequent nickel plating. This technique will cover up the finer pits not completely removed in the polishing operations, as the soft copper is smeared over the pits during the buffing or flowing operation. An indication as to whether the polishing has been thorough enough will come during this flowing operation, when drag marks or "fish-tails" will show up if the pits have not been sufficiently removed by the coarser abrasives. After nickel plating, the usual cycle for chrome, etc., should be followed.

Porous Chrome Plating

Question: Can you give us the formula for a chrome bath to produce porous chromium on worn parts that we are trying to salvage?

H. A.

Answer: Porous chrome is produced by first plating on the chrome under closely controlled conditions, depending on the type of porous chrome desired. Either the "pit" or "channel" types of porous chrome may be produced by varying the CrO_3/SO_4 ratio and the bath temperature, followed by suitable etching to produce the pits or channels. High CrO_3/SO_4 ratios and higher temperatures tend to produce a chrome deposit that will produce the channel type porosity after etching. Current densities are about the same as used for regular hard chrome plating. Etching is usually carried out anodically in a chromic acid solution, but immersion etching in solutions of Hydrochloric or Sulfuric acid are also

used. This etching step is quite critical and must be closely controlled.

Deburring Delicate Parts

Question: We are interested in obtaining information on methods for deburring small, delicate parts without using barrel methods, as the barrel methods seem to damage the parts too much and also round certain edges where rounding is not desired. Can you give us any suggestions?

E. A. B.

Answer: In a recent article which appeared in *Metal Finishing* (October 1948) the author discussed the barrel finishing of delicate parts requiring close dimensional control and fine finish. Perhaps your barrel methods can be improved so that the method can be used, as it is the most economical method available. You might also consider electropolishing, which in your case would probably be quite costly, as it would involve masking off those spots where rounding was not wanted and also racking and unracking. Another method would be liquid blasting, where the parts are subjected to a high pressure stream of abrasive suspended in water. Depending on the size and shape of the parts, this method might be applicable to your problem.

Hard Gold Deposits

Question: We have heard that there is a material that can be added to gold solutions to cause the deposit to be much harder. Our present deposits seem to be too soft and wear away too rapidly. Can you give us some help on this?

A. A. W.

Answer: Plating alloys of gold, such as gold-copper, gold-nickel, etc. will produce harder deposits than pure gold. A number of formulas are usable, one of the more common using nickel additions up to about ½ oz./gal. of Nickel Cyanide. Some changes in current density or operating temperature may be required in order to match colors. High current densities and lower temperatures tend to favor the deposition of secondary metals in composite gold plating baths, which will result in harder deposits.

Copper Plating over Chrome

Question: In some of our experimental work we have tried to deposit copper over a chrome plate, but we have not succeeded in obtaining good adhesion between the two, although the copper seems to plate out all right. We are using a cyanide copper bath, and have tried several methods of cleaning, but without success. Can you shed any light on this problem?

O. A.

Answer: We have never run across an application like this before. Perhaps our readers may be able to suggest how this can be accomplished successfully. It would seem that the problem revolves around getting an active surface on the chrome, then copper plating it before it had a chance to become passivated again. Our suggestion would be to try a few seconds treatment of the chrome plated parts as the anode in the copper plating tank, then reversing the polarity, making the parts cathodic immediately.

Dear Editor:

Included among the shop problems in the December issue was a query on acid copper plating. I would like to add something to your answer.

Lead anodes may still be used in acid copper baths without difficulty, if one provision is made. Instead of using pure lead anodes, an alloy of lead with one per cent silver should be used. This will prevent or at least considerably reduce the formation of lead oxide.

If, on the other hand, all copper anodes are used as you suggest, and if it is not possible to remove these when the tank is not in use, another remedy to prevent chemical solution is possible. A very small reverse current at about one volt may be applied when the equipment is not in use. This should properly control the copper content of the solution.

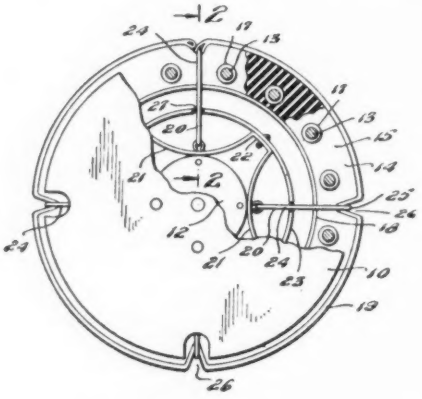
Very truly yours,
M. R.

Patents

Abrasive Wheel with Flexible Resilient Rim

U. S. Patent 2,451,753. *Miles E. Landau.*

In an abrasive wheel, a hub having side plates disposed in spaced relation to provide a circumferentially extending space therebetween, a flexible resilient tread of annular formation

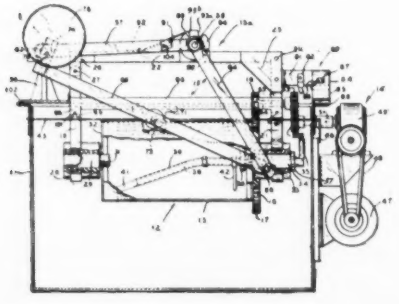


mounted between the side plates with the outer peripheral portion thereof protruding beyond the peripheries of said plates, said side plates having accurately spaced trunnions extending through apertures in the tread for loosely supporting the tread thereon between the said plates and permitting radial movement of the tread, and an annular spring band freely arranged between said side plates in surrounding relation with the hub on which the inner periphery of the tread is resiliently supported.

Electroplating Machine

U. S. Patent 2,451,676. *Norman K. House, assignor to Lasalco, Inc.*

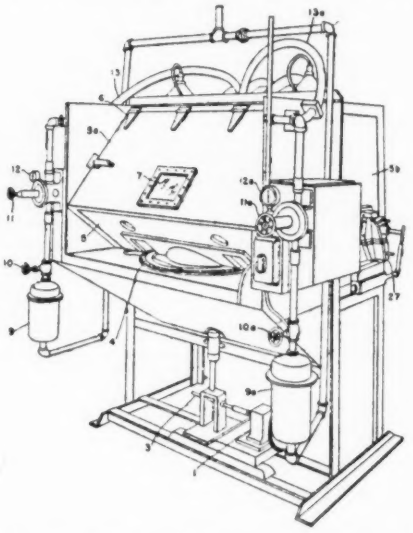
In an electroplating device having a tank, a barrel and a counterbalanced supporting structure for moving the said barrel from a point within to a point without said tank, the combination of a frame for mounting said barrel on said supporting structure, and means forming a part of said frame carrying an end closing cover for said barrel pivotably movable to open and close said barrel.



Abrasive Finishing Machine

U. S. Patent 2,451,049. *Alta W. Tell, assignor to Stupakoff Ceramic & Mfg. Co.*

An abrasive finishing machine comprising a housing, a turntable mounted in said housing in a manner so as to have a portion thereof projecting exteriorly of the housing through an aperture thereof, a plurality of pockets on said turntable for seating articles whose surfaces are to be blasted and thereby finished by an abrasive fluid. gun means mounted in said housing above said pockets to direct a blast of said abrasive fluid on said pocketed articles and a flexible mask mounted on said turntable and having a plurality of cutaway portions registering with

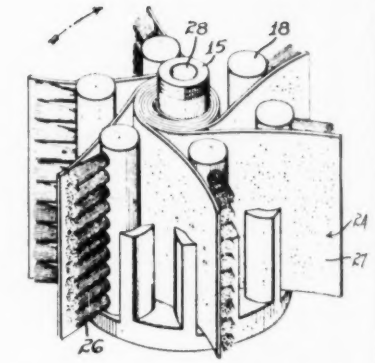


said pockets, and means overhanging said turntable for lifting only a portion of said flexible mask during rotation of the turntable in order to uncover said portion of the turntable projecting exteriorly of the housing.

Rotary Abrading Device

U. S. Patent 2,452,409. *Wiley W. Wickman.*

In a rotary abrading device, the combination of: spaced end members connected by a central axial member, a plurality of spacers positioned at intervals around the central member and extending between the end members, abutments provided on at least one of the end members extending adjacent

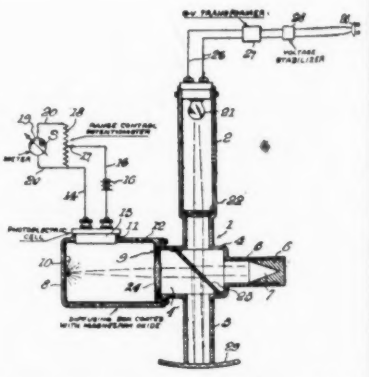


said spacers, a plurality of abrasive strips encircling the central member and each having an end thereof extending outwardly between one of the spacers and the adjacent abutment, and means on the end members for moving the spacers radially outwardly to clamp the abrasive strips between the spacers and the abutments.

Specular Reflectometer

U. S. Patent 2,451,501. *William Liben.*

Apparatus for measuring the light reflectance from reflective surfaces, using a source of light for illuminating the interior of a housing, said housing having an opposite open end adapted to engage the reflective surface of a test object, a collimating lens, a pair of oppositely directed arms opening into the housing, said arms forming a pair of oppositely directed chambers, one of which is a light trap chamber, the other of which is a light-energizing chamber, light-responsive-means mounted in the light-energizing chamber, and a focusing lens mounted in the light-energizing chamber, the said focusing lens for transmitting and focusing the light reflected from the test surface and thence from the mirror against the end of the light-energizing chamber, the light-responsive means receiving light transmitted by the focusing lens and becoming energized whereby the reflectance of the test surface may be determined.



Process for Producing Modified Nickel Anodes

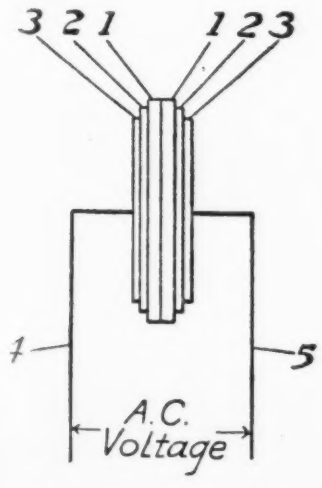
U. S. Patent 2,453,757. *Louis Secondo Renzoni, assignor to The International Nickel Co., Inc.*

A process for producing electro-nickel having good activity as anode up to pH 5.5 (Q.) in nickel electroplating baths and corroding as anode at pH up to 5.5 (Q.) without the production of undesirable amounts of loose nickel and sludge, which comprises purifying an electrolyte containing nickel and at least one of the group of impurities consisting of copper, iron, arsenic and lead to obtain a purified electrolyte substantially devoid of said impurities, positively introducing an effective amount of an electrolyte-soluble sulfur-bearing compound selected from the group consisting of sulfur dioxide and sulfites and acid sulfites of the alkali metals and alkaline earth metals into said purified electrolyte, electro-depositing nickel from said purified electrolyte to obtain electro-nickel containing about 0.005% sulfur to about 0.03% sulfur, and subjecting said electro-nickel to heat treatment at temperatures of about 1500°F. to about 1800°F. in a non-oxidizing atmosphere.

Selenium Rectifier Element

U. S. Patent 2,455,176. *Carl E. Holmes, assignor to Fansteel Metallurgical Corp.*

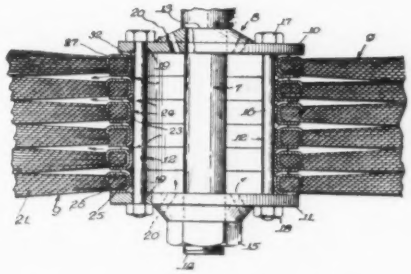
In a method of producing selenium rectifier elements the steps which comprise connecting electrically like electrodes of two selenium rectifier elements and applying to the other pair of electrodes an alternating current voltage of from about 18 volts to about 30 volts for a sufficient period of time so as to develop a high resistance in the elements in the reverse direction, the magnitude of this resistance being such that upon application of a direct current voltage of about 8 volts in the reverse direction the leakage current will not exceed about 0.5 milliampere per square centimeter.



Buffing Wheel

U. S. Patent 2,455,098. *Louis M. Seelenfreund, assignor to Action Buffs, Inc.*

As a new article of manufacture, a section adapted in conjunction with like sections and a hub structure to form a buffing wheel and comprising a plurality of annular juxtapositioned fabric layers and a core extending around and serving to secure together the inner marginal portions of the layers and embodying a preformed rigid one-piece ring consisting of a cylindrical base flange, an annular outer side flange extending outwards from the outer margin of the base flange and arranged in lapped relation

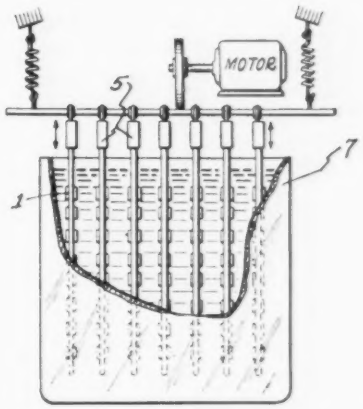


with the inner marginal portion of one of the outer-most fabric layers, and a circular series of spaced apart teeth connected to the outer margin of the outer side flange, projecting in the same direction as the base flange and embedded in the inner marginal portions of certain of the fabric layers, and a complemental pre-formed rigid one-piece ring positioned reversely with respect to the first mentioned ring and consisting of a cylindrical base flange fitting within the base flange of said first mentioned ring, an outer annular side flange extending outwards from the outer margin of the base flange of the complemental ring and arranged in lapped relation with the inner marginal portion of the other outermost fabric layer, a circular series of spaced apart teeth connected to the outer margin of the last mentioned side flange, projecting in the same direction as the first mentioned teeth and embedded in the inner marginal portions of certain of the fabric layers, and a lip connected to, and extending outwards from, the free margin of the base flange of said complemental ring, arranged in lapped relation with the outer side flange of said first mentioned ring, and serving to hold the two rings against separation.

Metallizing Non-Metallic Bodies

U. S. Patent 2,456,082. *Leopold Pessel, assignor to Radio Corp of America.*

A method of metallizing a non-metallic object which comprises immersing said object in a bath consisting of a mixture of two solutions A and B, of which solution A consists of ammoniacal silver nitrate and solution B consists of silver tartrate, said mixture being made up such that it contains a ratio of silver present as tartrate to silver present as ammonia compound of the order of 0.3 to 0.5.



Electroplating Corrosion Testing Specimens

U. S. Patent 2,453,904. *Leo D. Grenot, assignor to Shell Development Co.*

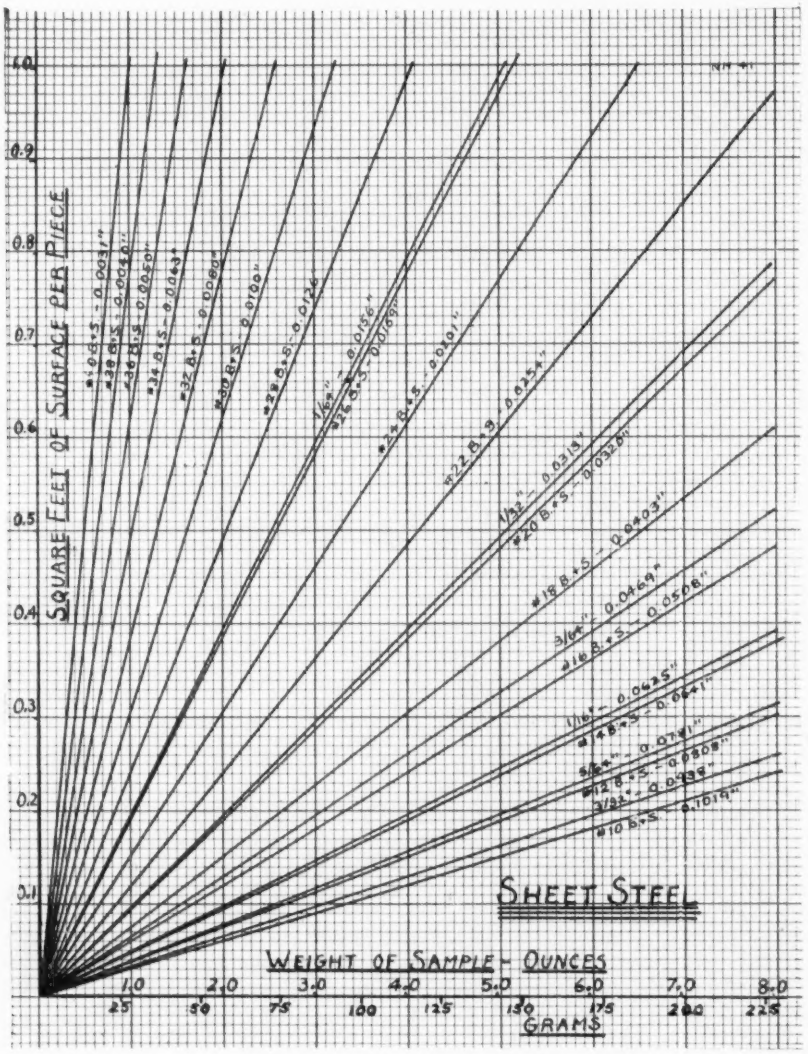
In a method of preparing a corrosion testing element of the class described, electroplating a test metal on a metal carrier having linear scorings at predetermined intervals to form a thin stepped-wedge plating of test metal thereon by immersing said carrier by predetermined increments corresponding to said linear scorings to bring said scorings successively substantially to the level of the plating bath and electrically depositing test metal on the immersed portion of said carrier in a predetermined amount after each successive immersion, thereby forming a test metal step-wedge on said carrier, the steps of said wedge coinciding with said scorings.

Determining Areas of Sheet Metal Parts

1 — STEEL STAMPINGS

The following chart may be used for estimating with sufficient practical accuracy the total plating area of parts made from flat sheet steel. This chart does not take into account the considerable amount of edge area that may be present on the heaviest parts made of thick stock, which can be easily measured and added to the figures found on this chart, nor the areas to be subtracted for holes. All that is required is the weight per piece and thickness of the stock used.

For parts heavier than those included in the chart, the area can be estimated by figuring first the area of a part one-half or one-quarter the weight of the sample part, then multiplying by the appropriate factor of two or four as required.



(Data by N. Hall & G. B. Hogaboom, Jr.)

New Methods, Materials and Equipment for the Metal Finishing Industries

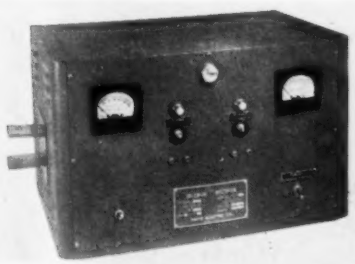
Recent Developments

Combined Reverse-Current and Rectifier Units

Rapid Electric Co., Dept. MF, 2847 Middletown Road, Bronx 61, N. Y.

Recently announced by this firm is a line of electroplating power units incorporating into a single unit both

a current-reversing device and a rectifier. Models are available in sizes from 250 amperes up to 1000 amperes, and have been designed after long research for the purpose of simplifying the power equipment requirements of the plater who wants to take advantage of this newest of plating techniques to produce sounder, smoother deposits from ordinary plating baths. In addition to the well-known features of the Rapid full-wave and conservatively rated rectifier, each unit includes individual controls for both forward and reverse current in smooth, stepless progression, and accurate timing controls, fully adjustable, for close timing of both the plating and deplating cycles. The unit can be used separately as a conventional rectifier if desired. All circuits are protected with overload cutouts. A 250 amp. unit is shown above.



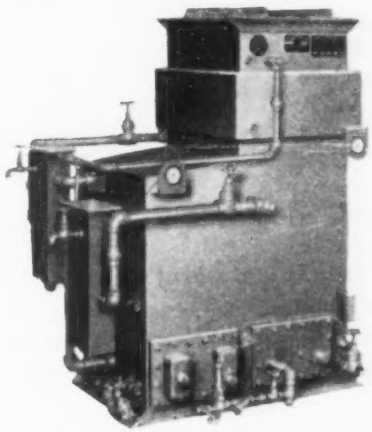
The firm also manufactures a line of current-reversing units that can be used with existing rectifier units to give a complete reverse-current plating outfit. Such a unit is also shown in the above photo, which is of 500 amp. capacity.

Complete details may be obtained by writing to the firm at the above address.

Drying Equipment for Plated Parts

Detrex Corp., Dept. MF, Detroit 32, Mich.

This firm announces their new Per-Ex dryer for electroplated parts that is claimed to produce spot-free drying for all types of metals and after all types of plating cycles. The method obsoletes sawdust tumbling, compressed-air drying, wiping, and other slow, costly drying methods. The machine utilizes Per-Ex liquid solvent, which quickly boils off any water remaining on the parts and leaves the surfaces clean and absolutely dry. The time required for this drying is less than a minute in most cases, it is claimed. Literature is available describing the process and equipment in detail by writing to the firm at the above address.

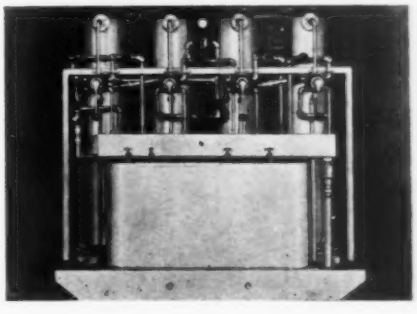


Water Demineralizers

Industrial Filter & Pump Mfg. Co., Dept. MF, 1621 W. Carroll Ave., Chicago 12, Ill.

With the establishment of an Ion Exchange Deparment, this firm is introducing a complete line of water demineralizers. These demineralizers deliver the chemical equivalent of distilled water at only a small fraction of the cost of distilled water. No heat and no stills are required, and the dissolved mineral salts in the water are removed by a simple chemical action and absorption in passing the water through beds of ion-exchange resins.

Depending upon the hardness of the



raw water and the volume required, these ion-exchange demineralizers are available in a variety of sizes and models. For laboratory work, a cartridge unit, shown above, delivers approximately five gallons per hour. Larger units, in both two- and four-bed models, deliver up to 1000 gallons per hour. Special units of any capacity are engineered to requirements.

Further information and descriptive bulletins are available from the manufacturer.

Flexible Belt Grinder

Hammond Machinery Builders, Dept. MF, 1601 Douglas Ave., Kalamazoo, Mich.

The above firm announces a new addition to their wide line of abrasive

belt grinding and polishing equipment. The Model V-2WP shown is a Wet-N-Dri flexible belt grinder and is especially suited for the wet deburring and finishing of plastics or metals. It offers advantages of free belt, contour or platen finishing and takes an abrasive belt up to 2½" wide.

This machine is not limited in use as it is suited for deburring, grinding, polishing, shaping, chamfering, squaring, etc., on ceramics, wood, rubber, glass, bone, ferrous and non-ferrous metals, according to the manufacturer.

Model V-2WP is shown with self-contained tank and pump unit. This same machine is available for connection to water main or can be used dry by shutting off the coolant supply.

Water Soluble Buffing Compounds

Special Chemicals Corp., Dept. MF, 30 Irving Place, New York, N. Y.

The above firm announces that they

are now marketing water soluble cutting and coloring compounds for the metal finishing industry.

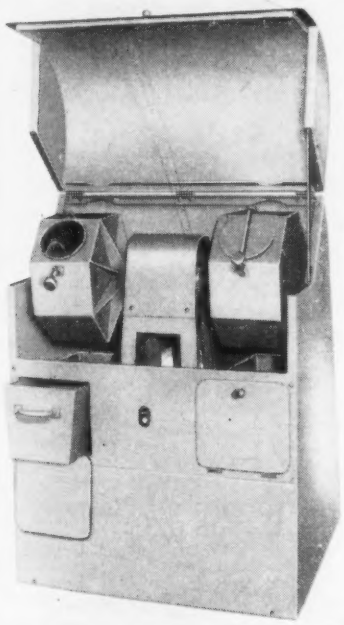
Of paramount interest to polishers is the fact that these red rouges and tripoli are water soluble, therefore minimizing cleaning problems. These polishing compounds have the latest innovations involving the scientific control of the grain size of abrasives used, it is claimed, already have had a long period of industrial acceptance, according to the manufacturer.

A bulletin describing these materials will be sent upon request to the above address.

Almco Announces New Tumbling Unit

Almco Division, Queen Stove Works, Inc., Dept. MF, Albert Lea, Minn.

The newest addition to Almco's Supersheen line of precision tumbling barrels is MODEL DBO-1 as shown. This recent development in mechanical deburring and finishing affords maximum convenience and minimum cost to the manufacture of small parts or on small production runs, it is claimed.



It is also recommended and used in experimental deburring and finishing. It is equipped with safety switch, switch box and ½ H. P. electric motor (220-440 volt, 60 cycle, 3 phase, 1750 R.P.M.). New innovations include variable speeds from 35 to 70 R.P.M., which can be changed while machine is in operation, all welded steel construction with removable unloading drawers with drain and removable

screen, and quick-opening and and closing water-tight doors. Available for immediate delivery.

Third Dimension Magnifying Spectacles

Paul H. Gesswein & Co., Dept. MF, 35 Maiden Lane, N. Y. 7, N. Y.

The above firm announces a line of magnifying spectacles giving a three-dimensional field of view. These spectacles are extremely useful in inspection work and work involving small parts and assemblies. Models are available for attachment to regular eyeglass frames for those who customarily

require eye glasses, while for those who do not need eye glasses there also is a model available.

These Telesights are made in long, medium, and short focal lengths for various types of work, and give complete freedom of both hands at all times. The lenses are easily pushed up out of the way whenever necessary. As the frames are of a standard shape, it is possible to mount prescription lenses directly into the frames.

High-Strength Gummed Tape

Minnesota Mining & Mfg. Co., Dept. MF, 900 Fauquier St., St. Paul, Minn.

A paper tape strong enough to compete with metal strapping and rope for heavy duty packaging was announced by the above firm recently. It has a tensile strength of 180 pounds per inch of width, and is designated No. 320 in the "Scotch" brand industrial tape line. It will be available nationally this month, according to the producer. Use of the tape eliminates packaging equipment and saves workmen cuts and similar injuries, the producer declared. The tape is thin (13-15 mils) and flexible. It has a pressure-sensitive ad-

hesive which grips immediately upon contact. The tape is designed for use in packaging metal pipes, conduits, rods, rolls, sheets, coils, fittings and tubing, by wrapping it once around the load and back on itself, the producer said. It is also expected to be used in the shipping of stoves, metal cabinets and other household equipment, as well as window frames, doors, trim, raw lumber, wall board, panels, and plywood sheets.

Strength of the tape is attributed in part to reinforcing the paper backing with threadlike fibers running lengthwise. The fibers, imbedded permanently in the adhesive, also afford a tear resistance greater than can be measured by the ASTM-approved Elmendorf Tear Tester—greater than 1600 gram-centimeters.

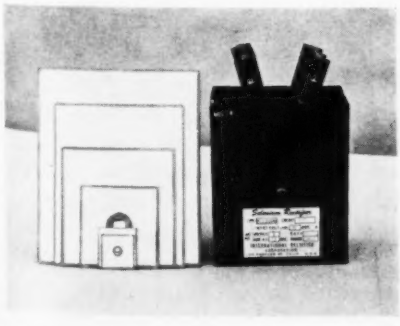
The new tape has more than twice the strength of its strongest predecessor in the line—"Scotch" Super Strength —and more than three times the tensile strength of "Scotch" Extra Strength tape.

Both the Super Strength and Extra Strength tapes are being continued for use in in packaging jobs which do not require the exceptional strength built into the new tape.

Selenium Rectifiers

International Rectifier Corp., Dept. MF, 6809 S. Victoria Ave., Los Angeles 43, Calif.

The above firm, sole Los Angeles manufacturers of selenium rectifiers and self-generating photo electric cells, has developed a complete new line of selenium rectifiers covering the range from 2 volts and 150 milliamperes to 5000 volts and 10,000 amperes. The individual plate sizes range from 1¼" x 1¼" to 6¼" x 7¼", the latter size being the largest plate commercially available in the U. S. The plates are assembled in a unique interlocking arrangement between the plate and insulating sleeving so as to prevent possible plate rotation or lug misalignment.



The individual selenium plates are capable of withstanding 24 volts rms maximum in the reverse direction and can be overloaded up to 10 times rated load for periods of 7 seconds or less, according to the firm. Its characteristics are also extremely stable since the leakage is less than 1 ma/cm² at maximum reverse voltage. Efficiency varies from 65% to 85% depending upon the circuit employed and the change in voltage is less than 5% after the first 10,000 hours of operation, it is claimed.

Water Soluble Tripoli Composition

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

The above firm has developed two compositions, 2-S-10 and 2-S-12, that are water-dispersable, and at the same

time have superior working properties. In fairness to users, it must be pointed out that while the performance characteristics of the new 2-S-10 and 2-S-12 water soluble Tripoli compositions are good, the cutting properties and composition and buff "mileage" do not quite measure up to the best in the standard Hanson-Van Winkle-Munning group.

They will be useful on work where the composition tends to pack and thus gives rise to a cleaning problem. They may also be useful in cases where the performance is good enough and the main attraction is ease of cleaning.

Composition 2-S-10 is recommended for the heavier-duty jobs where more cut is required and maximum solubility is not the primary prerequisite.

Composition 2-S-12 is very dry and should be used on filigreed work and the like where cleaning is a real problem and heavy cut not so essential.

Both compositions have the advantage of being firm and less likely to crumble, as well as the more important properties of good performance.

The company will be glad to supply these compositions for trial orders.

Stainless Membrane for Titeflex Filters

Titeflex, Inc., Dept. MF, 546 Frelinghuysen Ave., Newark 5, N. J.

A new wire mesh membrane which can be used in any standard Titeflex filter has been developed by this firm.

The wire mesh membrane is a cylinder constructed of Type 316 stainless steel Dutch weave wire cloth and supported on the inside by a 1/16" thick perforated cylinder with a ring on each end to act as a bearing surface. Mesh of the standard membrane is 20 x 250, but membranes can be furnished in any mesh required. All joints of the membrane are welded.

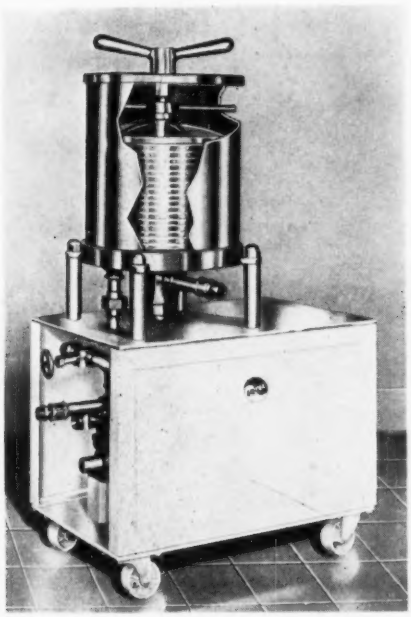
The new wire mesh membranes can be used with either Filterbestos or diatomaceous earth as filtering mediums, and they are interchangeable with the porous stone membranes in Titeflex filters. They successfully withstand high pressures and high temperatures, it is claimed. Because the wire mesh membrane can be used to filter any solution which does not attack Type 316 stainless steel, its range of applications is very wide. It can be used without a filtering medium when solutions have fairly large suspended particles and only a fine straining operation is required.

Due to the very thin wall of the cylinder there is no danger of plugging and the wire mesh construtcion eliminates the possibility of breakage, according to the firm. Either the wire mesh membrane or the porous stone membrane can be supplied as standard on Titeflex filters, according to which is specified by the purchaser.

Cylinder Type Disk Filter

Ertel Engineering Corp., Dept. MF, 18 Front Street, Kingston, New York.

The above firm announces the development of a new Positive Seal Cylinder Type Disk Filter to be known as Model ECD. The filter incorporates a new principle of double closure to insure a positive seal. The filtering elements are independently tightened from the cylinder. This method permits the use of various types of rigid



filter media in any number up to the rated capacity of the filter. A wide field is also opened here for multiple use of the unit for various operations. After the filtering elements are sealed the outer cylinder is independently closed by a separate handwheel.

Due to the enclosed principle there is no loss of liquid due to evaporation or drippage, a feature which makes the filter adaptable for handling volatile liquids, it is claimed. Model ECD is built so the filter effects a positive seal between the filter medium and the inlet and outlet channels. This eliminates the danger of by-passing unfiltered liquid.

The filter is arranged to make reloading and cleaning as simple as possible. By removing the head and the cylinder the entire unit is exposed. Standard inlet rings can be substituted for wider inlet rings (sludge rings) when it is necessary to absorb considerable amounts of solids. For greater capacity filtration multiple units are recommended.

New Air Backstand

Hammond Machinery Builders, Inc., Dept. MF, Kalamazoo, Mich.

The Hammond Model 3-A Air Backstand was designed for heavy production grinding or polishing with abrasive belts.

The Model 3-A has an air actuated cylinder which automatically maintains correct belt tension—compensating immediately for a fraction of an inch of belt stretch. Different pieces of material require different belt tension. After correct tension is determined, operator merely sets pressure regulator valve.

The Model 3-A is of heavy cast-iron construction except for stainless steel 12″ diameter 7″ face idler pulley. Pulley is diametrically balanced and runs on highest quality sealed ball-bearings.

Free literature available.

Metal Cleaning and Finishing Machine

Armstrong Chemical and Machine Co., Dept. MF, Painesville, Ohio.

The above firm announces the new "Jet Blast" machine for wet abrasive blast cleaning and finishing of metal surfaces. The "Jet Blast" method removes rust, scale and undesirable metal particles, such as feather edges on sharpened tools, by projecting a slurry of fine abrasive suspended in water against the surface to be cleaned. The large permissible variation in abrasive size (60 to 1250 mesh) makes it commercially possible to produce finishes as low as 2-3 micro-inches r.m.s., it is claimed. The method produces a matte finish with practically no removal of metal. Specifications of standard models are: 30″ x 30″ cabinet, 77″ high, one blast nozzle and exhaust blower direct connected to ¼ HP motor; and 48″ x 42″ cabinet, 108″ high, one to eight blast nozzles and exhaust blower direct connected to 1 HP motor. Cabinet and frame are water-tight welded steel construction.

New All-Purpose Cold Solder

Alvin Products, Inc., Dept. MF, 20-22 Houghton St., Worcester 4, Mass.

Applied with an ordinary putty knife, free spreading Alvin Lab-Metal fills blow holes, sand holes, surface blemishes and rough or porous places in metal castings. Hardens in minutes to a strong permanent bond that can be sanded to a perfect feather edge, ground and painted without requiring heat or special tools, it is claimed.

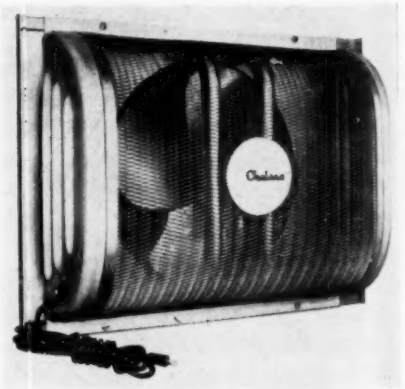
Alvin Lab-Metal safely seals joints, cracks, gaskets—fills cracks and solders over bumps, rope welds, holes, pits and gouges. Can be thinned with any regular lacquer thinner and brush painted or sprayed on. Will not shrink or crack, and is waterproof and rust-proof, according to the manufacturer.

Available in pints, quarts or gallons.

Window Fan

Chelsea Fan & Blower Co., Inc., Dept. MF, 1206 Grove Street, Irvington 11, N. J.

This firm announces portable, direct drive, three speed window fans



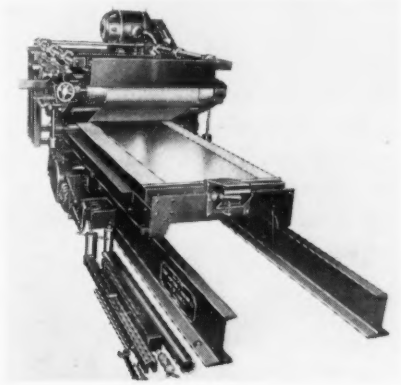
equipped with extension cord and three speed switch. Finished in baked enamel. Panels fit window openings

from 25" to 36". The 16" fan delivers 1550 c.f.m. and the 20" delivers 2100 c.f.m. Both fans are equipped with a 1/15 HP motor. The three speed control provides air in volumes as desired and operates exceedingly quietly, it is claimed.

Sheet Polishing Machine

Excelsior Tool & Mach. Co., Dept. MF, East St. Louis, Mo.

The above firm announces its new sheet polishing and grinding machine,



capable of handling sheet stock up to 48" wide and 144" long. The machine uses belts for grinding which can be removed for changing in a matter of a few minutes. The machine is ruggedly constructed for long continuous service, and has ball-bearing mounted drums for the belts. At the end of the polishing cycle the motor is automatically shut off so the processed sheet may be removed. Any weight up to 600 lbs. can be applied to the polishing rolls, it is claimed, and the design of the machine assures even pressure over the entire width of the sheet. Equipped with a 30 HP motor for the belt and a 2 HP motor for reversing the carriage. A free folder describing the machine may be obtained by writing to the above address.

Business Items

H. J. Kingsbury Completes 50 Years With Hammond

Henry J. Kingsbury, Chief Engineer of *Hammond Machinery Builders, Inc., Kalamazoo, Mich.*, is in the enviable position of holding down a job and still being able to do as he pleases, as he enters partial retirement after 50 years of service with the company.

H. J. Kingsbury

He has, in his half century of service, had much to do with placing his company's products in the forefront of the polishing, buffing and deburring fields through what has developed into a wide line of grinders, lathes and automatics, employing both wheels and abrasive belts.

His co-workers and friends pay him the tribute of never having heard him utter an unkind word nor of ever having had anyone question his word.

He will continue active with the company in its engineering research and development—a position in which he can come and go as he pleases and still continue in a field of work in which he finds his major enjoyment.

Pennsalt District Office in Appleton, Wis.

The Pennsylvania Salt Mfg. Co. has announced the opening of a new District Sales Office in Appleton, Wis., on January 1, for its Heavy Chemicals Division. *C. H. Anderson*, of Pennsalt's Chicago office, has been placed in charge as District Sales Manager.

The new office will enable Pennsalt to give faster and better service to the large and varied industries it has been serving in that area for many years.

Du Pont Announces Grants to Universities

The Du Pont Company announced that it is instituting a program of grants-in-aid to ten universities for the 1949-50 academic year for unrestricted use in the field of fundamental chemical research. The program, which at the start will be on a trial basis, has the aim of raising the amount of such research being done in this country above present levels, with a view to "stock-piling basic knowledge."

In announcing the new program, *Crawford H. Greenewalt*, president of the Du Pont Company, said that these grants-in-aid are designed to help insure the flow of fundamental knowledge in science upon which the future industrial development of our country and the standard of living of the American people are so dependent.

The ten universities to which grants-in-aid of $10,000 each are being offered are California Institute of Technology, Cornell University, Harvard University, Massachusetts Institute of Technology, Ohio State University, Princeton University, Yale University, University of Illinois, University of Minnesota, and University of Wisconsin.

The grants are being awarded for the academic year of 1949-50, but it is the company's hope, should the program work out satisfactorily, to continue each of them for a period of five years. The universities themselves will select the research projects in which the grants will be employed, the only stipulation being that they be free from any commercial implicaions at the time the work is initiated.

Mr. Greenewalt emphasized that there would be complete freedom in the communication and publication of the results of the research work supported by these grants.

Diversey Announces New Executive Appointments

B. M. Kaple, formerly Cleveland Div. manager for The Diversey Corp., has been elected president of The Diversey Corporation of Canada, Ltd., according to announcement by *H. W. Kochs*, chairman of the board.

Mr. Kaple's elevation to head of the Canadian company provided for advancement of three other men in the Cleveland Division. *R. L. Ware*, formerly district manager, has been appointed division manager to take Mr. Kaple's place, and *J. M. McMurtry* and *R. W. Raffety*, formerly senior salesmen, have moved ahead to district managerships.

From his initial work as field service

B. M. Kaple

R. L. Ware

representative, Mr. Kaple was appointed Cleveland Division manager in 1945.

Mr. Ware joined Diversey in June, 1943, as a fieldman. In January, 1946, he was promoted to district manager. Before coming to Diversey he was sales promotion manager for a large drug and candy manufacturer, and at another time general superintendent of a large chain organization. He attended Michigan State University's School of Agriculture, following which he served as a field marketing inspector with the United States Department of Agriculture.

Mr. Raffety began as a fieldman with Diversey in February, 1942. In January, 1946, he became a senior salesman. Prior to his association with Diversey, he supervised salesmen for an Ohio organization in the heating field. He attended Ohio State University.

Mr. McMurtry joined Diversey in September, 1945. Less than a year later he became a senior salesman. Before becoming a member of the Diversey organization, he spent six years in sales training and advertising with a large Pittsburgh department store. He attended the University of Pittsburgh.

Buckeye Observes 40th Anniversary This Year

The *Buckeye Products Co., Cincinnati, O.*, manufacturers of Speedie Buffing & Polishing Compositions, and suppliers of various polishing room accessories, will observe its 40th anniversary this year.

During that period the company has had three locations in Cincinnati, now being situated in its own modern building which was erected some years ago. In order to take care of increased manufacturing demands prompted by additional business, a plant expansion program was instituted in 1947, being completed last year. Installation of a modern laboratory for development purposes and production control, increased manufacturing facilities, and new and enlarged offices were recently finished so that the company is in excellent condition to take care of its considerably expanded business.

Speedie buffing and polishing compositions may be obtained from jobbers' warehouses in the East, mid-West and Pacific Coast. Considerable tonnage is exported annually to all parts of the world.

George A. Stutz Company Appointed Sel-Rex Distributor

The *George A. Stutz Mfg. Co., of* 1645 *Carroll Avenue, Chicago,* has signed as an official distributor of Sel-Rex Selenium Rectifiers, we are advised by The *Bart-Messing Corp.*, manufacturers of Sel-Rex equipment.

The George A. Stutz Mfg. Co. is one of the oldest and largest supply firms serving the metal finishing industry. Their reputation as an organization, marketing only the finest quality equipment is well known.

New Almco Distributor for St. Louis Area

The *Brite Deburring Co.*, 2612 *South 13th St., St. Louis,* has recently

been appointed authorized distributor in that area for the complete line of Almco precision deburring and finishing barrels, auxiliary handling equipment, and materials and compounds. *Mr. R. C. Trow*, Almco Manager, in announcing this appointment, also states that the Engineering Clinic for the St. Louis area will also be under the able supervision of *Mr. Richard K. Conradi*, President and General Manager of Brite Deburring Company. This clinic will be a complete installation to duplicate shop conditions and will be available for sample processing without cost to manufacturers of small metal parts in the St. Louis area. Details may be obtained by writing or calling Mr. Richard K. Conradi, President, Brite Deburring Company, 2612 South 13th Street, St. Louis, or Mr. R. C. Trow, Manager, Almco Division, Queen Stove Works, Inc., Albert Lea, Minn.

Glover Expands Facilities for Corrosion-Resistant Lining

Glover Coating Co., Inc., 376 *Washington St., of Malden, Mass.*, has completed installation of handling machinery for heavy tanks and of additional vulcanizing facilities. The company's potential output of protective coatings on customers' tanks, plating racks, and other equipment has been increased by 60% and deliveries are expected to be correspondingly improved, according to the firm.

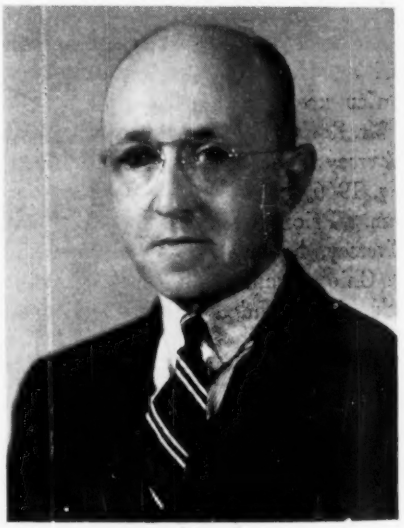
The company offers heavy-duty insulations of rubber, synthetic rubbers, vinyl compounds, baked phenolics, and polyblend paints.

Course in Practical Plating Starts Feb. 9th

The College of the City of New York, School of Technology, will offer a course in Practical Electroplating, registration beginning February 9, on Monday evenings, 12 weeks, 2 hours per week. The primary objective is to provide commercial electroplaters with a sound understanding of the principles underlying their work. For details address *Dr. Bernard Levy*, City College, New York 31, N. Y., or phone WA 6-5400 during business hours.

Maneely Chemical Names Nolan Sales Manager

Maneely Chemical Co., which has opened a new $500,000 plant in Wheatland, Pa., on January 1st, has appointed *William J. Nolan* sales manager. The firm is a subsidiary of Wheatland Tube Co. and has been formed to produce zinc chloride, zinc sulphate and ferric oxide. The Maneely plant is modern in every detail, the newest in its field.



Wm. J. Nolan

Mr. Nolan, a Philadelphian with 27 years experience in the chemical business, graduated from Notre Dame, and has worked for such firms as Grasselli, the General Dyestuff Corporation, Ellis Jackson and Company, Glidden Company, and for the past 12 years he has had his own chemical brokerage business. Mr. Nolan is a member of the Chemists' Club of New York, the Philadelphia Chemical Club and the Whitemarsh Valley Country Club.

Pennsalt Subsidiary to Handle Foreign Activities

Leonard T. Beale, president of *Pennsylvania Salt Mfg. Co.*, announced the organization of *Pennsalt International Corp.*, a subsidiary, which will take over the varied foreign interests of the parent company. *Richard L. Davies* is president of the new firm and *John H. S. Barr* is vice-president. Mr. Davies is Assistant to the President of the parent company for which Mr. Barr has been Export Manager since 1944.

The new company will import and export chemicals and raw materials. In addition it will perform an invaluable service to American and foreign industry in the exchange of technical information relating to chemical processes. It will handle imports for the parent company, which has been a heavy importer of raw materials for its own chemical production for nearly a century.

Mr. Davies, who joined Pennsalt in 1934, has traveled widely and for years has been a profound student of international relations. A chemist by profession, his patents on chemical manufacturing processes are used in the United States and many foreign countries. In World War II he was civilian scientific consultant to Chemical Warfare Service in the European theatre. He is a member of the Aluminum and Magnesium Industry Advisory Committee of the Munitions Board and chairman of the Board's Industrial Advisory Committee on Security, which is concerned with protection of industrial installations vital to national defense.

An alumnus of Yale, Mr. Davies is a member of numerous technical societies, including the Chemical Market Research Association, of which he is a founder and past vice-president; American Chemical Society, Electrochemical Society, Society of Chemical Industry, and the Board of Trustees of the Academy of Natural Sciences. He is a member of the board and past chairman of the Foreign Policy Association of Philadelphia and a member of the Council on Foreign Relations.

Mr. Barr, vice-president of Pennsalt International, is a licensed engineer who was graduated in 1927 from Lehigh University as a Mechanical Engineer. He joined the Engineering Department of Pennsalt, the parent company, in 1929, later transferring to technical sales. He became Export Manager in 1944 when Pennsalt's Export Division was established. His travels in the interest of Pennsalt's export business have taken him into most of western Europe and through virtually all of South America and the West Indies.

He is a member of the Export Managers Club of New York; a director of the Foreign Traders Association of Philadelphia and chairman of its Transportation Committee.

Amer-Craft Products Streamlines Production

To meet its fast-growing production schedule, *Amer-Craft Products, Not Inc.*, manufacturer of buffs, has placed its entire plant on an assembly line basis, employing mobile carriers from operation to operation.

All processing is accomplished on one floor of its new plant at 1024 *South California Ave., Chicago, Ill.* Materials, stored on a lower floor, are moved by means of an elevator and rolling bins to the fabricating tables, thence to the power machine batteries and finally to the finishing and shipping departments.

Upon completion of this arrangement, *Mr. Louis M. Shapera*, co-owner and general manager, stated that the company's new stream-lined method of manufacture, together with its case-history system of developing buffs for the specific application of its customers, insures a continuous flow of uniform and consistent wheels.

Employee Suggestion Plans

Executives responsible for the administration of employee suggestion plans are unanimously agreed that a continuous publicity campaign is a necessity for a successful suggestion program.

Prompt decisions on suggestions, both in making awards for acceptable suggestions and in putting the suggested changes into effect, are other prime necessities for a successful program, the report shows. In fact, many employees are more interested in seeing their suggestions put to use than they are in monetary rewards.

"Suggestion Plans for Employees," which was prepared as a service to companies which provide Metropolitan Group insurance programs for their employees, is designed to furnish executives with the information needed to initiate a suggestion plan, or to make improvements in an existing plan. The suggestion plans of 45 companies engaged in both manufacturing and nonmanufacturing operations were analyzed during the preparation of this study.

While the report was prepared primarily for Metropolitan Group policyholder companies, a limited extra supply is available. Executives may obtain copies by writing on their business stationery to the *Policyholders Service Bureau, Metropolitan Life Insurance Company*, 1 *Madison Avenue, New York* 10, *N. Y.*

Special Chemicals Adds New Salesman

Special Chemicals Co., of 30 *Irving Place, N. Y. C.*, announce that *Mr.*

Joseph Calabrese

Joseph Calabrese will cover the state of New Jersey in the capacity of a salesman for them.

Mr. Calabrese formerly had his own electroplating business where he specialized in copper, nickel, brass and many other electroplated finishes. His being in the electroplating field places him in the footsteps of his father, *Mr. Dan Calabrese*, who is a well-known member of the Newark branch of the American Electroplaters' Society.

Nelson Chemical Appoints New Representatives

Nelson Chemicals Corp., of Detroit, Mich., announces the appointment of the *S. A. Day Mfg. Co., Inc., Buffalo, N. Y.*, as jobbers for the Metropolitan Buffalo area for Gripmaster polishing wheel cement and the appointment of the *Corl Chemical Co., Seattle, Wash.*, as jobbers for the same product for the State of Washington.

Diversey Holds 25th Anniversary Conference

The *Diversey Corp.*, 53 *W. Jackson Blvd., Chicago*, a leading firm in the field of industrial chemicals—cleaning compounds, disinfectants, insecticides—signalized its 25th anniversary with the largest technical and engineering conference in its history Dec. 13-17 in the Edgewater Beach Hotel, Chicago.

Guest speakers who addressed various general sessions are *Dr. Samuel N. Stevens*, president of Grinnell College;

L. N. Bauman, vice-president of White Motor Company, Cleveland; and *Harry Simmons*, management consultant, New York. From small beginnings in 1923, Diversey has grown to the point where more than 100 different products are marketed under its label. As a yardstick of growth, the corporation began with two fieldmen, while today the total sales organization exceeds 300 men. Diversey set up shop in a one-room office near Navy Pier, Chicago, in September, 1923, and a month later chalked up its first sale—a keg of ammoniated cleaner for dishwashing and cleaning walls.

The organization expanded rapidly in the years directly ensuing. Branch offices were opened in Kansas City and Detroit in 1924. Executive offices were moved to larger quarters in 1925.

Early salesmen could have outpointed the professional brawn and muscle boys in the bulging biceps department, for their daily calls on customers required them to carry a "Boston bag" filled with 20 demonstration samples weighing a pound each. The idea was to use up all samples each day. It was during this period that "Don't just say it—*Demonstrate* it!" became a standard feature of the sales approach.

New products were added each year, and Diversey "went national" in 1929. Heavy direct mail advertising paved the way for D-Man calls. Sales training classes to equip D-Men for selling and servicing the full Diversey line were inaugurated in 1933.

The company further expanded in 1937 with formation of *The Diversey Corporation of Canada, Ltd.*, now employing more than 50 men and women, with headquarters in Toronto. A number of old-line companies were acquired from time to time, their products being added to others bearing the Diversey label.

Diversey's home office headquarters have been in the Monadnock Building, Chicago, since 1926. Originally, only two offices were occupied. Today, the organization has all of one floor, and part of three others.

Detrex Declares Stock Dividend

Detrex Corporation, Detroit 32, *Mich.*, manufacturers of industrial and drycleaning equipment and chemicals, has just paid a quarterly common stock dividend of 15c per share to stockholders of record January 3, 1949.

Poly-Cyclo Announces Executive Appointments

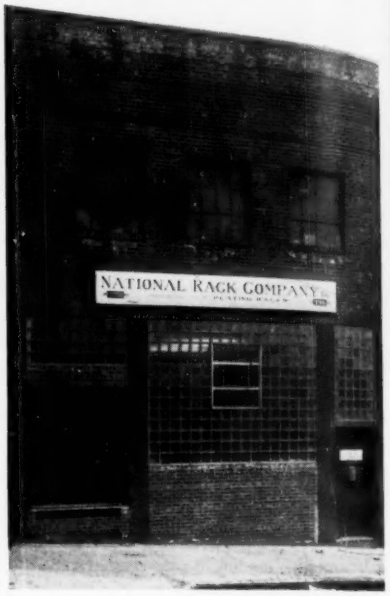
William A. Munkacsy, former Chief Chemist of the research laboratories, plastics and synthetic division of the United States Stoneware Co., organizer and now president and technical director of *The Poly-Cyclo Products Co., Cleveland, O.*, announces the appointment of *Ray W. Grace* as vice-president and *Ernest A. Munkacsy* as secretary.

Mr. Grace was sales manager of the United States Stoneware Company's plastic and synthetic division previous to his appointment as vice-president in charge of technical sales through the company's industrial affiliate, *Munray Products, Inc.* Secretary Ernest A. Munkacsy will assumme the duties of plant production control manager.

The firm manufactures protective items such as corrosion resistant plastic and synthetic paints, electroplating rack coatings, tank linings, plastic extrusions and sheeting, together with various correlated rubber products.

National Rack Company Inc. Increases Plant Facilities

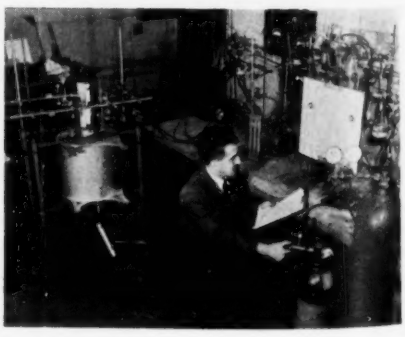
Demand in the electroplating field for properly engineered plating racks has forced the *National Rack Co., Inc.*, to seek new and larger quarters in order to substantiate their promise of



ten days to two weeks delivery. More manufacturers and processers are recognizing the fact that to buy a tool engineered and manufactured by a firm which specializes in plating racks is far less expensive in the long run than to try to satisfy production demands with a plating rack made in their own plant by personnel to whom rack making is a side line. This fact has increased National Rack Company's production to the point where additional floor space and more modern machinery is necessary to help meet the demand. The new plant is located at 396 *River St., Paterson, N. J.*, and customers and friends have been extended a cordial invitation to visit the new plant.

Research on High Temperature Coatings

Mr. R. B. Wagner, chemical engineer



at New York University College of Engineering, regulates flow of hydrogen gas into a quartz tube electric furnace. This work is part of a special research project sponsored by the research and development division of the *Loewy Construction Co., Inc.*, of New York. The purpose is to determine properties of a chromium alloy coating produced on the surfaces of various high temperature metals while in the furnace. Objective of the research is to develop coatings that will withstand oxidation at extremely high temperatures.

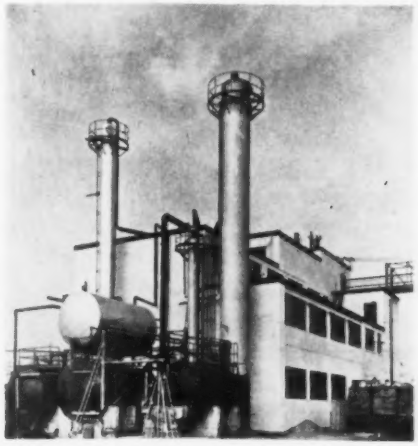
Oakite Celebrates 40th Anniversary

February this year holds particular significance for *Oakite Products, Inc.*, 22 Thames St., N. Y. C., pioneers in the field of industrial cleaning materials and methods, as it marks the completion of Oakite's fortieth year of cooperation with industry on its production and maintenance cleaning procedures.

John A. Carter, General Manager of the company, in commenting on the increasing utilization of its methods and products by industrial plants, stated that the 40 years of successful achievement can be attributed in large measure to the company's fundamental policy of rendering a service first and selling a product on the side. Since its founding in 1909, the company has steadfastly stressed service over and beyond the mere sale of its products. In support of this policy, it mainains a nationwide field service organization of 180 experienced technical representatives to provide in-plant assistance and to assure the most effective and economical applicaion of its materials by its customers. Testimony to the effectiveness of this basic principle is indicated by the fact that the company now supplies more than 80 specialized compounds for cleaning and related operations in the metal field and in many other branches of industry.

New Trichlorethylene Manufacturer

The *Niagara Alkali Company* announces the construction at Niagara Falls of a new plant for the production of trichlorethylene, a chlorinated solvent widely used in industry chiefly as a degreasing and metal cleansing agent. The plant is expected to be in operation early this year.



According to *J. C. Cassidy*, president of Niagara Alkali Company, the manufacture and sale of trichlorethylene is in line with the company's program to provide greater diversification of its chemical products.

Associations and Societies

NATIONAL ASSOCIATION OF METAL FINISHERS

Board of Directors Meeting

The Board of Directors of the National Association of Metal Finishers, Inc., will hold its Spring meeting on Monday, March 7, 1949 at the Neth-

erland Plaza Hotel, Cincinnati, Ohio.

There are a number of vital decisions for the Board of Directors to decide but the agenda has not yet been prepared for release.

All members of the Board who are planning on attending this meeting should make their reservations immediately by writing to *Mr. Dan Hickey*, Reservation Manager, Netherland Plaza Hotel, Cincinnati 1, Ohio.

Members of the Association as well as members of the industry are cordially invited to attend this meeting, and any subjects which they wish to be placed upon the agenda should be forwarded to the office of the Secretary on or before Feburary 15, 1949.

The Annual Meeting of the N.A.M.F. will be held in June, 1949, at Milwaukee, Wis., the date and place of such meetings will be announced later.

AMERICAN ELECTROPLATERS' SOCIETY

New AES Research Project to Investigate Current and Metal Distribution in Electroplating

The *American Electroplaters' Society* recently inaugurated Research Project Number 11 on "*Current and Metal Distribution in Electroplating*" at Evansville College, Evansville, Ind. The director of the project will be *Dr. John Kronsbein*, who is Head of the Department of Engineering.

The experimental work will include the electrodeposition of various common metals on a variety of standard geometric shapes of the types usually encountered in the metal forming and die casting industries, under varying current densities and bath compositions. These deposits will then be accurately measured for metal thickness. It is hoped that the data collected in this manner will enable electroplaters to more accurately choose suitable electroplating conditions to obtain satisfacory metal distribution on complex geometric shapes.

Dr. John Kronsbein is well qualified to conduct research in this field since he has previously published a number of excellent theoretical investigations on this subject in the *JOURNAL OF THE ELECTRODEPOSITORS TECHNICAL SOCIETY and the PROCEEDINGS OF THE LONDON MATHEMATICAL SOCIETY*. The measurements which will be carried out under this project will reveal how much theo-

retical current distribution deviates from that encountered in actual practice.

The Project Committee is made up of *Dr. R. A. Schaefer*, of Cleveland Graphite Bronze Co., Cleveland, O., Chairman; *Dr. Harold Weisner*, of Bendix Products Div., Bendix Aviation Corp., South Bend, Ind.; and *Leonard Weeg*, of National Lock Company, Rockford, Ill.

New York Branch

The New York Branch of the American Electroplaters' Society will hold their Annual Educational Meeting and Banquet on Saturday, February 26th, at the Statler Hotel (Pennsylvania).

The Educational Session will start at 2:00 P.M., with the following subjects and speakers:

1—Precious Metal Plating—by *Mr. Edward Rinker*, Bart-Messing Corp.
2—Introduction to Metal Evaporation —by *Mr. Harold Narcus*, Technical Director Electrochemical Inds.
3—Electro Polishing of Stainless Steel —by *Mr. Kenneth Huston*, Rustless Iron & Steel Corp.

The Annual Banquet will be held in the evening, including a floor show and dancing. For reservations write to *Mr. F. J. MacStoker*, 25 Princeton St., Garden City, Long Island, or to the Detrex Corp., 350 Fifth Avenue, Room 4113, New York 1, N. Y.

Twin City Branch

The January Meeting of the Twin City Branch of the American Electroplater's Society was on Monday, January 3rd, 1949, at the Lodge Room of the Covered Wagon in Minneapolis. There were twenty-six persons present.

The meeting opened with a discussion on the "*Practical Points on Chromium Plating*" given as a part of the series of plating discussions. The lecture was given by *Bob Buckley* of Industrial Chemical and Equipment Company, Branch Secretary-Treasurer, and the round-table discussion following was led by *Ralph B. Maddock* of Pako Corporation. It was agreed that the discussion on Chromium Plating be continued at the February meeting.

Following dinner, President *Frank Ireland* of Brown and Bigelow, Inc., introduced the guests. They were: *Kenneth La Croix* and *Norman Christopherson*, both of Minnesota Metal Finishing Company, "*Slim*" *Cady* and *Vince Sebatka* of Northwest Airlines, and *Al Boe* of W. D. Forbes Company. It was announced that the February meeting entertainment would be the showing of the 1948 Minnesota Football movies. Frank Ireland also announced that the Nominating Committee would be appointed at the February meeting.

Following the business session, Branch Librarian *Wray Schorr* of Hiawatha Metalcraft Company introduced *Mr. Frank Savage*, Past President of the National Society who spoke to the Branch on "Plating Racks." Frank's talk was very interesting and all of the members were pleased to have him visit our Branch.

Chicago Branch

At the December meeting of the Chicago Branch, held at the Atlantic Hotel on Dec. 10th and attended by over 100 members and guests, the usual technical session was postponed and the evening devoted to entertainment in the form of movies, sandwiches, and refreshments. The evening's fun was enjoyed by all, the only complaint being that there should have been a larger attendance of members of the fair sex. Several new members were elected, including *David Fisher*, of Merchant's Chemical Co.; *John Jumer*, of Electro-Glo Co.; *Robert Leland*, of Udylite Corp.; and *Robert Ruenzel*, of Ardco, Inc.

The January meeting featured "Old Timer's Night," and was attended by 77 members.

Mr. Rowe, Mr. Ralph Pettit, Rudy Hazucha, and *Jerry De Grazia* were the speakers. Each revealed the tried and true formula for success—perseverance, a little ingenuity, and cooperation between individual members and branches. They all seemed to enjoy the pioneering curiosity needed in those days to be a successful plater as well as having a sincere spirit of cooperation to help others succeed in all phases of metal finishing.

The Chicago Branch is justly proud of its many "old timers" and wishes them and all other members continued success for many years to come.

Two new members were elected: *Mr. Edward W. Smith,* of the Geo. Stutz Co., and *Lloyd Arms,* of Arms Laboratories.

The Branch received an invitation to attend the Grand Rapids Annual Banquet and Educational Session, and went on record as being in favor of raising the per capita tax from $4.70 to $5.70 providing the additional dollar will be used for the Research Fund.

A suggestion was made to help identify individual members at monthly meetings. A small lapel pocket card with the person's name would help everyone to know their fellow members better.

Dayton Branch

The Annual Educational Session and Banquet of the Dayton Branch of the American Electroplaters Society will be held on February 12th at the Miami Hotel, Dayton, O.

The following list of outstanding speakers has been invited to provide the technical program:

1—*George Jernstedt,* Director of Electroplating Research, Westinghouse Mfg. Co. *"Periodic Reverse Plating."*

2—*Dr. Louis Weisberg,* Consultant. *"Leveling in Nickel Plating."*

3—*Dr. R. A. Schaeffer,* Director of Research, Cleveland Graphite Bronze Co. *"The A.E.S. Research Program."*

In the evening the Annual Banquet will be held, and will include top-notch entertainment and dancing.

Baltimore-Washington Branch

The December meeting of the Baltimore-Washington branch was held at Mullineaux's Lodge in Catonsville, Md., on Dec. 14th. A large attendance turned out to hear *Dr. William Blum,* Director of the Chemical Division of the Bureau of Standards and the most prominent figure in the electroplating field, discuss "The Interest of the Federal Government in Electroplating."

Dr. Blum demonstrated the extensive interest of the Federal Government in electroplating. He illustrated his talk with some of the interesting questions and problems brought to him by over 30 agencies of the Federal Government. The Government's interests in electroplating stem from problems in law enforcement, taxation policies, research, and specifications or service requirements. This extremely interesting talk pointed up the importance of electroplating to this country.

One new member was elected, *Senor Carlos A. Luna,* Ciudad University, Bogota, Colombia (South America).

The January meeting, held at the Dodge Hotel, Washington, was attended by 75 members and guests. *Mr. G. A. "Jerry" Lux,* of Oakite Products, Inc., gave a very interesting talk on the cleaning of articles for plating.

Mr. Lux illustrated his talk with

graphic charts, demonstrating how careful balancing and compounding of materials produce the most satisfactory cleaning results. For demonstration purposes he came equipped with about three dozen bottles containing cutting oil, buffing chips, water softeners, hard water, cleaning agents, etc. He gave a very entertaining description of the advantages and disadvantages of the various methods of cleaning metals such as (1) alkali cathodic and anodic electro cleaning and the importance of high conductivity, PH control, water softening and colloidal agents and inhibitors with this method; (2) alkali soak cleaning with such elements as borates, caustic soda, caustic potash, complex poly-phosphates, crystallized tri-sodium phosphate, soda ash, sodium carbonate, sodium solicates, synthetic wetting agents, and emulsifiers; and (3) organic emulsion cleaning with compounds of coal tar or petroleum solvents coupled with different kinds of emulsifiers.

Following the educational session, the members were entertained by professional dancers and singers as they refreshed themselves with free beer and coke.

Los Angeles Branch

In an extemporaneous talk on automatic plating presented at the January 12 meeting of Los Angeles Branch, *American Electroplaters' Society*, in Scully's Cafe, *Don M. Bedwell*, superintendent of the Hallenscheid-McDonald Co. of Los Angeles, stressed proper pre-cleaning as one of the most important phases of automatic plating operations. Mr. Bedwell briefly touched upon the different types of automatic plating —air-driven systems, electrically-driven setups and hydraulically operated installations, etc.

One of the things to be highly desired in any system is a quick transfer, so the work will not have a chance to oxidize, Mr. Bedwell stressed, and stated that in his own shop the chrome line is geared to 25 second transfer, where they run die castings and brass together and aim at a deposit of .0002"-.0003" copper on the die casting before transferring to nickel.

Mr. Bedwell then described the practices used with automatic plating machines in his plant, explaining the types of copper, nickel and chrome solutions found most practical for their operations, how pre-cleaning work is handled, and other details of operation.

What was probably the most spirited open-forum discussion ever held at a branch meeting followed the conclusion of Mr. Bedwell's remarks. Participating in the discussion were such well known finishing executives as *Ray Bray* of Crown City Plating Co., Pasadena; *Ray Baugh* of Cadmium & Nickel Plating Co., Los Angeles; *Earl Arnold* of the L. H. Butcher Co., Los Angeles, who was formerly supervisor of plating at the Cadillac plant in Detroit, and a number of others.

Mr. Bray expressed the opinion that he could not see much advantage in automatic plating for a job shop unless it had a great many pieces of work of nearly the same type and kind. Mr. Arnold cited as one of the chief disadvantages the inflexibility of an automatic setup.

Mr. Baugh described some of the experience with automatic setups in the Cadmium & Nickel Plating Company's plant. He concurred with other speakers on the point that only large volume of work would warrant the use of an automatic system in a job shop.

The consensus of opinion was that

initial cost of equipment, the need to keep it busy the entire working day, and the size limits imposed by the dimension of the cleaning tank, definitely make a fully-automatic setup impractical for a small job shop, or even for a fairly large shop which cannot feel sure of a reasonable frequency of jobs of fairly uniformedly sized parts in volumes of at least 15,000 to 25,000 at a time.

Los Angeles' coldest night in history and the unusual spectacle of snow-covered streets did not deter 90 members from attending the session. Guests present included the following: *William Sorenson*, Kelite, Inc.; *William Carter*, Process Equipment Co., Chicago; *Mike Kadich*, Southwest Plating Co.; *Burt Nash*, Richardson-Allen Co.; *John Bell*, Progressive Plating Co.; and *Robert Hungerford*, Modern Plating Co.

A motion that the branch incorporate as a non-profit organization, in conformance with a recommendation made by the Supreme Society, was unanimously adopted.

ASM

Sixth Western Metal Congress

Announcement was made by *W. H. Eisenman*, National Secretary, American Society for Metals, that the Sixth Western Metal Congress and Western Metal Exposition will be held in Los Angeles at the Shrine Auditorium, April 11th through April 15th, 1949.

This Western Metal Congress and Exposition will again be under the management of the American Society for Metals, sponsors of the annual Metal Congress and Exposition in the East.

A fine technical program is being developed by the A.S.M. in cooperation with the Western Sections of 20 other National technical societies. Leading scientists from both the metals producing and consuming industries will participate in making the Western Metal Congress a timely source of vital information on all phases of metal science. Manufacturers of basic materials as well as processors of all types of industrial products will display the latest developments and techniques of their business in what is promised to be the most comprehensive and impressive exposition yet held on the West coast.

The Western Metal Congress and Western Metal Exposition will be by and for the manufacturers and the scientists located in the eleven western states. Metals themselves, metal processes and product assembly will reflect the progress and ability of this important industrial area through technical and educational sessions and through the display of products on the floor of the Shrine Auditorium.

SAE

New Officers Elected

Announcement of the election of a 1949 president, three councilors, 12 vice-presidents, and a treasurer of the Society of Automotive Engineers was made at the business session of the SAE 1949 Annual Meeting in Detroit on January 11th.

The new president of the 43-year-old engineering society is *Stanwood W. Sparrow*, vice-president in charge of

engineering of the Studebaker Corp., South Bend, Ind.

Newly elected councilors, who will serve a two year term, are *G. E. Burks*, chief engineer of Caterpillar Tractor Co., Peoria, Ill.; *N. H. Daniel*, manager of the Diesel Engine Division, General Motors Products of Canada, Ltd., Oshawa, Ont., and *E. A. Ryder*, consulting engineer, Pratt & Whitney Aircraft, East Hartford, Conn.

Vice-presidents, who with the president and treasurer were elected to serve one year terms, will each become the directing head of an SAE Professional Activity. They are:

R. C. Loomis, Consolidated Vultee Aircraft Corp., San Diego, Calif.; *Dr. Karl Arnstein*, Goodyear Aircraft Corp., Akron, O.; *Frank S. Spring*, Hudson Motor Car Co., Detroit, Mich.; *Max M. Roensch*, Ethyl Corp., Detroit, Mich.; *H. B. Knowlton*, International Harvester Co., Chicago, Ill.; *H. L. Moir*, Pure Oil Co., Chicago, Ill.; *George B. Allen*, Chrysler Corp., Detroit, Mich.; *L. C. Goad*, General Motors Corp., Detroit, Mich.; *L. A. Gilmer*, Oliver Corp., Charles City, Ia.; *J. L. S. Snead, Jr.*, Consolidated Freightways, Inc., Portland, Ore.; *E. P. Lamb*, Truck Division, Chrysler Corp., Detroit, Mich.

B. B. Bachman, vice-president, Autocar Co., Ardmore, Pa., was reelected treasurer of the Society.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS

1949 Conference and Exhibition

The fifth annual Conference and Exhibition of the *National Association of Corrosion Engineers* will be held April 11-14, 1949, at the Netherland-Plaza Hotel, Cincinnati, Ohio.

The technical program will include symposia on Corrosion Principals, Cathodic Protection, Chemical Industry, Communications and Electrical Industries, Gas Industry, General Industry, Oil Industry, Protective Coatings, Pulp and Paper Industry, Salt Water Corrosion, and Transportation Industry, with papers by authorities in these fields. The Exhibition, with displays by various manufacturers, will show the latest methods, materials, equipment and services for combating corrosion.

Following is the tentative schedule:

APRIL 11—Symposium on Corrosion Principles. Papers: "Why Metals Corrode," by *H. H. Uhlig*, Massachusetts Institute of Technology, Cambridge, Mass.; "The High Temperature Corrosion of Metals," by *Hugh J. McDonald*, Loyola University, Chicago, Ill.

APRIL 12—Chemical Industry Symposium. Papers: "The Pulse Polarizer in Corrosion Technology," by *Glenn A. March*, The Pure Oil Co., Northfield, Ill., and *Hugh J. McDonald*, Loyola University, Chicago, Ill.; "Physical and Corrosion Characteristics of Lead in the Chemical Industry," by *Kempton H. Roll*, Lead Industries Assn., New York; "Corrosion Tests in the Processing of Soap and Fatty Acids," by *W. Z. Friend* and *J. F. Mason, Jr.*, International Nickel Co., New York; "Plant Corrosion in the Fatty Acid Industry," by *R. J. Paul*, Emery Industries, Inc., Cincinnati, O.

APRIL 12—Electrical and Communications Industries Symposium. Papers: "Corrosion Protection of Power Transformers by Flow Coat Method," by *Siebert L. Miller*, Union Electric Co. of Missouri, St. Louis, Mo.; "Corrosion Testing of Buried Cables," by *T. J. Maitland*, American Telephone and Telegraph Co., New York; "Field Experience with Corrosion Protection of Galvanized Steel Substation Structures" by *Siebert L. Miller*, Union Electric Co. of Missouri, St. Louis, Mo.; "Use of Dry Disc Rectifiers as Valves in Electrolysis Drainage Return Wire," by *W. D. Connon*, Bell Telephone Co., of Pennsylvania, Philadelphia, Pa.

APRIL 13—Cathodic Protection Symposium. Papers: "Electrolysis Experiences on 115 KV High Pressure, Oil Filled, Pipe Type Cable Installation in New Orleans," by *S. E. Trouard*, New Orleans Public Service, New Orleans, La.; "Engineering Aspects of Cathodic Protection as Applied to Pipe Lines," by *E. P. Doremus, G. L. Doremus* and *M. E. Parker*, Cathodic Protection Service, Houston, Texas; "Cathodic Protection Distribution in Some Zinc Steel Systems," by *T. P. May*, The International Nickel Co., New York, and *George S. Gordon*, Northwestern University, Evanston, Ill.; "The Corrosion Products on Zinc Anodes Used Underground," by *E. A. Anderson*, The New Jersey Zinc Co., Palmerton, Pa.

APRIL 13—Pulp and Paper Industry Symposium. Papers: "Major Corrosion Problems in the Pulp and Paper Industry," by *Roy Whitney*, Institute of Paper Chemistry, Appleton, Wisc.; "Round Table Discussion" led by *H. O. Teeple*, The International Nickel Co., New York; "Corrosion of Digesters and Related Equipment," (Author unannounced), A. O. Smith Co., Milwaukee, Wisc.; "Non-Metallic Materials and Relation to Pulp and Paper Mill Corrosion Problems," by *Carl Richter*, Stebbins Eng. and Mfg. Co., Watertown, N. Y.

APRIL 13—General Industry Symposium. Papers: "Field and Laboratory Evaluation of Petroleum-Base Rust-Preventives," by *E. L. Walters* and *R. G. Larsen*, Shell Development Co., Emeryville, Calif.; "Erosion-Corrosion of Metals and Alloys," by *W. A. Luce* and *M. G. Fontana*, The Ohio State University, Columbus, O.; "Potential Relationship between Zinc and Iron in Various Natural Waters" by *R. B. Hoxeng*, Case Institute of Technology, Cleveland, O.; "Corrosion Characteristics of Titanium," by *P. H. Permar*, du Pont de Nemours and Co., Inc., Wilmington, Dela., and *G. E. Hutchinson*, Remington Arms Co., Bridgeport, Conn.

APRIL 13—Transportation Industry Symposium. Papers: "Corrosion Aspects of Fusion Welding Aircraft High Strength Aluminum Alloys," by *L. W. Smith*, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y.; "Application of Corrosion Resisting Materials to Railway Electrical Construction," by *H. F. Brown*, New Haven Railroad, New Haven, Conn.; "Electrolytic Corrosion of Steel in Concrete" by *G. M. Magee*, Association of American Railroads, Chicago, Ill.; "Some Factors Influencing Corrosion in the Automobile Body," by *W. R. Wiers*, Fisher Body Division of General Motors Corp., Detroit, Mich.

APRIL 14—Protective Coatings Symposium. Papers: "Porcelain Enamel as

a Corrosion Resistant Coating," by *G. H. McIntyre*, Ferro Enamel Corp., Cleveland, O.; "Shop Coat Primers for Steel," by *S. C. Frye*, Bethlehem Steel Co., Bethlehem, Pa.; "Writing Specifications for Organic Metal Protective Coatings," by *W. W. Cranmer*, Industrial Testing Laboratory, Philadelphia Naval Shipyard, Phila., Pa.; "Cationic Chemical Pretreatment of Metal Surfaces," by *Wm. T. Deacon*, Solvents and Plastics Co., St. Louis, Mo.

APRIL 14—Oil Industry Symposium. Papers: "Corrosion in Petroleum Processes Employing Aluminum Chloride," by *R. S. Treseder*, Shell Development Co., Emeryville, Calif.; (Title unannounced) by *E. Q. Camp*, Humble Oil and Refining Co., Baytown, Texas; "Anti-Corrosive Lubricants for Internal Combustion Engines," by *A. B. Culbertson*, Shell Oil Co., Wood River, Ill.; "Correlation between Corrosion Survey Results and Actual Conditions," by *I. B. Tietze*, Phillips Petroleum Co., Bartlesville, Okla.

APRIL 14—Salt Water Corrosion Symposium. Papers: "Corrosion Resistance of Aluminum and Aluminum Alloys in Sea Water," by *William C. Stewart*, U. S. Naval Engineering Experiment Station, Annapolis, Md.; "Corrosion of Steel Pipe by Chlorinated Sea Water at Various Velocities," by *V. B. Volkening*, The Dow Chemical Co., Freeport, Texas; "Corrosion of Steel Piling in Sea Water," by *H. A. Humble*, The Dow Chemical Co., Midland, Mich.; "Deterioration of Steel Piling at Palm Beach," by Beach Erosion Board, Washington, D. C.

APRIL 14—Gas Industry Symposium. Papers: "Cathodic Protection of Gas Distribution Systems," by *A. W. Peabody* and *C. L. Woody*, Ebasco Services Inc., New York; "Preparation of Reconditioned Pipe Surfaces for Effective Application of Bituminous Coatings," by *O. C. Mudd*, Shell Pipe Line Corp., Houston, Texas; "The Use of the Thermo Generator for Cathodic Protection," by *H. J. Findley*, Eaton Mfg. Co., Cleveland, O.; "Field Tests of Sodium Chromates and Alkalies for Controlling Corrosion in Gas-Condensate Wells," by *C. Kenneth Eilerts*, Bureau of Mines, Bartlesville, Okla.

Obituary

Gaylord L. Jones

Gaylord L. Jones, sales representative for the brush division of the *Osborn Mfg. Co.* in the southeastern states, died at his home in Orlando, Fla., on New Year's Day.

Mr. Jones joined Osborn in 1932

and was widely known throughout the southeastern United States, which he covered for the past 16 years. He moved to Orlando from Atlanta in 1940.

Mr. Jones is survived by his widow, two children, and two brothers. Services and burial were in Orlando.

Manufacturers' Literature

Cadmium Brightener

R. O. Hull & Co., Inc., Dept. MF, 1279 West 3rd Street, Cleveland 13, O.

Literature is available describing a new and greatly improved brightener for cadmium plating, ROHCO 20-XL, which enables production of unusually brilliant cadmium plate directly from the plating bath without a bright dip. The plating characteristics of cadmium baths containing this product are excellent with respect to wide range of current density, range of concentration and highest throwing power, it is claimed, with the maintenance cost for the brightener only about 2% of the plated cadmium metal.

Buffing and Polishing Wheels

New England Buff Co., Dept. MF, 493 C St., Boston 10, Mass.

The above firm, manufacturers of quality buffing and polishing wheels for 60 years, announce a new catalogue describing their complete line. One of the outstanding features of New England buffs is the facing operation performed on all buffs before shipment, making it ready for use in the customers plant with no further "raking," with its consequent loss of buff, required by the operator. All types of sewings are carried in stock, and specially constructed buffs are tailor-made to customers specifications whenever required. The complete line includes full-disc muslin buffs (loose, packed, or sewed), flannel buffs, jewelers buffs, pieced buffs, folded buffs, and specially designed ventilated types of buffs. Polishing wheels are made of canvas, muslin, felt, and leather, and range from soft to hard.

Copies of this bulletin may be obtained on request to the above address.

Storage, Handling and Feeding of Activated Carbon

Industrial Chemical Sales Div., West Virginia Pulp and Paper Co., 230 Park Avenue, New York 17, N. Y.

Of interest to all users of activated carbon is this 12-page pamphlet recently published by the above firm. The information contained in its pages was originally intended for the water purification field and first appeared in Industrial's book, "Taste and Odor Control in Water Purification." However, the problems on storing, handling and feeding of activated carbon are practically the same throughout industry in general and this reprint is now available to all users of activated carbon. The booklet discusses in some detail the shipment of carbon, storage of carbon, handling activated carbon, bag emptying equipment, fundamental

consideration in feeding, supplement to dry feed equipment, and solution feed equipment.

Copies of "Storage Handling and Feeding of Activated Carbon" may be obtained by writing to the above address.

Bulletin on Buffs

Amer-Craft Products, Not Inc., Dept. MF, 1024 So. California Ave., Chicago 12, Ill.

The above firm has just issued a bulletin describing their line of buffs. A full line is manufactured in various types of sewing and in various weights of cloths, and the company fully guarantees satisfaction when using their products. Copies of the brochure are available by writing to the firm.

Centrifugal Dryer for Small Parts

New Holland Machine Co., Dept. MF, New Holland, Pa.

A new catalog on the New Holland-Kreider centrifugal dryer has been just produced by the above firm.

The front cover shows one of the two 10-year-old Kreider Dryers still turning out top-notch work at Mechanical Plating Works, Detroit, Mich. Other pictures show cut-away views of the latest unit with steel woven mesh basket, the auxiliary steam heating unit and the auxiliary natural gas heating unit.

Specifications and other information is also included.

Polishing Wheels

Pressed Leather Wheel Co., Dept. MF, Dorf St., Herkimer, N. Y.

A bulletin just published by this concern tells the story of their line of polishing wheels, and includes a brief history of the development of the pressed type of wheel from the early days of the polishing industry.

In addition to its leather covered wooden wheels, this firm also specializes in pressed leather wheels and compress wheels. Their pressed leather wheel features the dovetail type of construction to firmly bond the leather face to the wood core. Their compress wheels are available in all densities. and in sizes from 12-24 inches in diameter, with faces from 1-4 inches wide. A copy of this bulletin is available on request.

New Bulletin on Industrial Instruments

Taylor Instruments Co., Dept. MF, Rochester, N. Y.

A completely revised edition of "Taylor Guide to Correct Instrument Selection" has just been published by this firm. In addition to giving a comprehensive bird's-eye view of the companies entire industrial instrument line, the field of application of each type of instrument is covered as well as its principle of operation and range limits.

The bulletin is prefaced by the basic types of Taylor Instruments as the first procedure in the process of logical and intelligent selection of instruments. Succeeding pages divide the instruments according to the variables to be measured or controlled such as temperature, humidity, pressure, flow, liquid level, force and time cycle. Special function instruments are treated separately and include time-schedule, pneumatic set, ratio, electric contact, remote pneumatic transmission, expansion-stem type and self-acting controllers. Diaphragm valves, lever motors and precision valve positioning units are also included in the same

section. Other pages give descriptions of mercury-in-glass thermometers for use on industrial apparatus and intermittent testing; etched-stem thermometers and hydrometers for laboratories and general industrial use; and information on Coordinated Control Systems.

Write for Bulletin 98170.

33rd Annual Review of the Silver Market

Published by Handy and Harman, 82 Fulton St., N. Y. C. Free.

Gives detailed production figures, prices, and uses for silver. Imports and exports of the metal, and legislation passed and pending are also discussed.

News from California

MacDermid Moves Los Angeles Office

Los Angeles office and warehouse facilities of *MacDermid, Inc., Waterbury, Conn.*, manufacturers of industrial chemicals, have been moved from 1011 *South Los Angeles Street, to* 119 *South Western Avenue. G. Stuart Krentel* is the company's western representative.

Universal Rack Company has been established at Alhambra, Calif., by *Willard Willin* to specialize in the design and manufacture of plating racks.

Willin operates in a new factory building with 3,000 square feet of floor area at 1516 *Orange Street, Alhambra.* His speciality is the building of racks

specification for dipping odd-shaped arts difficult to handle with conventional racks. He announces that he an provide any type rack coating esired.

A visitor to the West Coast in Januy was *P. B. Carter, Jr.*, president of e *Process Equipment Corporation*, hicago. Mr. Carter was in Los Anles in mid-January to confer with fficials of the *A. J. Lynch Co.*, western istributors for the Chicago firm's ater treatment and de-ionizing equipent and to supervise the installation a de-ionizing system in the plant of ienenfeld Enterprises.

Caroll McLaren returned January 1 om a nine months sojourn in Honolu to resume activity in the Southern alifornia plating industry as owner nd operator of a job shop in Santa na, Calif. In Honolulu he had headed he plating division of Auto Service ompany since the spring of 1948. He ad previously been prominent for a ozen or more years in Southern California as plating department head for various manufacturers.

A new factory has been completed on Eastshore Highway, Albany, Calif., for *Adhesive Products, Inc.*, of *San Francisco*, manufacturers of tape and sealing materials.

The *Liberty Plating Co.*, which formerly operated several divisions, has announced the consolidation of all its activities into one establishment at their new location, 5737 *W. Jefferson Blvd., Los Angeles* 16, *Calif.* The new plant is built on a four acre tract and contains 25,000 sq. ft. of manufacturing space. Visitors have been extended an invitation to visit the new plant.

TECHNICAL LITERATURE

Directory of Occupational Safety

National Safety Council, 20 North Wacker Drive, Chicago 6, Ill.

1949 Directory of Occupational Safety Posters. Prepared by the National Safety Council. A 72-page directory containing 744 illustrations of two, three and four color posters, classified under 15 sections. A convenient index that quickly locates posters on specific accident hazards. Posters range in size from 8½ x 11½ inches to 10 x 12 ft. Price 50 cents.

1—Porosity of Electrodeposited Metals

2—Methods for Testing Thickness of Electrodeposits

Published by the American Electroplaters Society, P.O. Box 168, Jenkintown, Pa. Price $.50 each.

The two booklets constitute Research Reports No. 10 and No. 11 respectively of the Research Program of the *American Electroplaters Society*. The method for porosity testing reported in this project report involves measurement of the rate of permeation of a non-corrosive gas through thin foils of the electrodeposited metal, and is applicable only to deposits after separation from their base metal. The report on the testing of thickness deals with the effect of residual stress in the deposits on the rate of attack by "jet" testing methods, and shows that ap-

preciable errors may be introduced due to this factor. Both reports are in the nature of progress reports, and further work in both these important fields is continuing and will be the subject of future publications.

Proceedings of the Third International Conference on Electrodeposition

Published by the Electrodepositor's Technical Society, 27 Islington High St., London N1, England. Price £2-10-0.

This paper bound volume contains all the papers presented at the Third International Conference held at London in 1947. Outstanding papers on electrolytic polishing, structure of deposits, alloy plating, treatments for zinc surfaces, porous chrome plating, copper plating and many other subjects are included by the world's most prominent electrochemists and engineers. Discussions which followed the various presentations are also included, making a very valuable addition to this worthwhile publication.

NEW BOOKS

Design of Industrial Exhaust Systems

By John L. Alden. Price $3.50. Published by the Industrial Press, 140 Lafayette St., N. Y. C.

Ventilation is an art which has

grown sharply in recent years, and this is particularly true of exhaust ventilation for the removal of undesirable heat, fumes, dust, vapors or otherwise contaminated air. While the principles involved are not especially new, a great deal more is known now than even a decade ago about the toxicity of various solvents, for example, and far greater use is now made of axial flow fans than was formerly the case.

For these reasons this book is now appearing in a second edition, completely revised and with new chapters as compared with the first edition published in 1939. Mr. Alden, who is assistant works manager of *Western Electric Company's* Kearny plant, has had wide experience with the subject, both as a designer of exhaust systems and also as installer and buyer of such systems. Based on this background, the book tells the reader how to design, build, or buy an exhaust system that will adequately and economically perform the functions required by law or prescribed by engineers or industrial hygiene specialists. The scope of the book includes exhaust ventilation, low pressure pneumatic conveying, design of hoods, piping and structural details and the selection of dust separators, centrifugal and axial flow fans. The book is practical in its approach, but based on the latest engineering developments.

The book contains 252 pages with 120 drawings and diagrams.

Jeweler's Workshop Practices

By Leslie L. Linick. Published by Henry Paulson & Co., 131 Wabash Ave., Chicago 3, Ill.

This 500 page book on the processes of the jewelry and precious metal working field contains a great deal of practical information, including short cuts, formulas, shop kinks, and former trade secrets. Various coloring and plating methods are detailed, as well as cleaning, polishing, burnishing, and preserving methods. Helpful information on the buying and testing of old gold articles is one of the more important features of the book. One criticism of this volume is the rather unorganized method of presenting all the facts on a given process or metal, references often being found far separated from the main discussions. However, the many thousands of helpful hints given should make the book a worth while addition to the library of anyone engaged in the working of precious metals and jewelry.

A. E.

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